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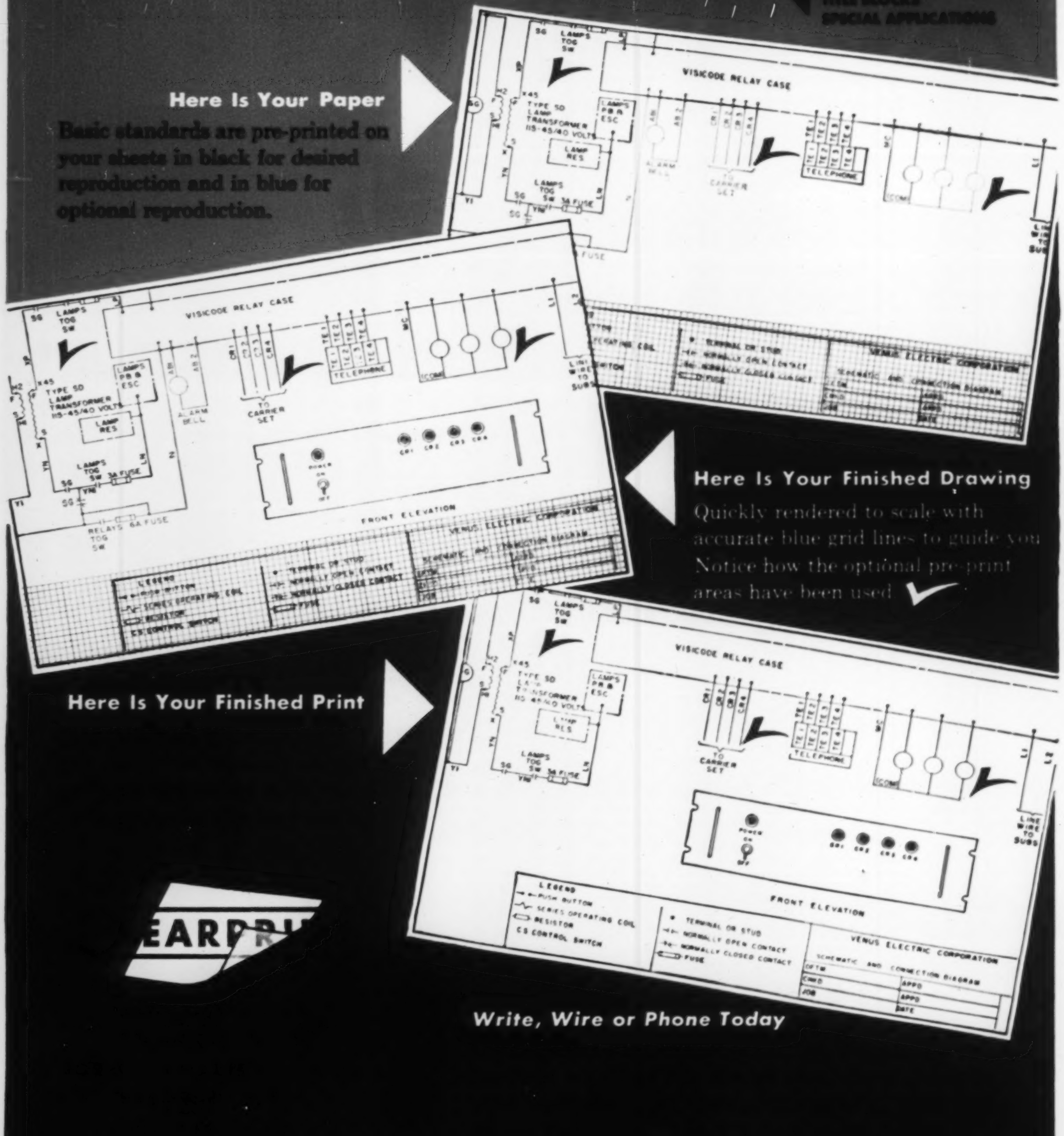
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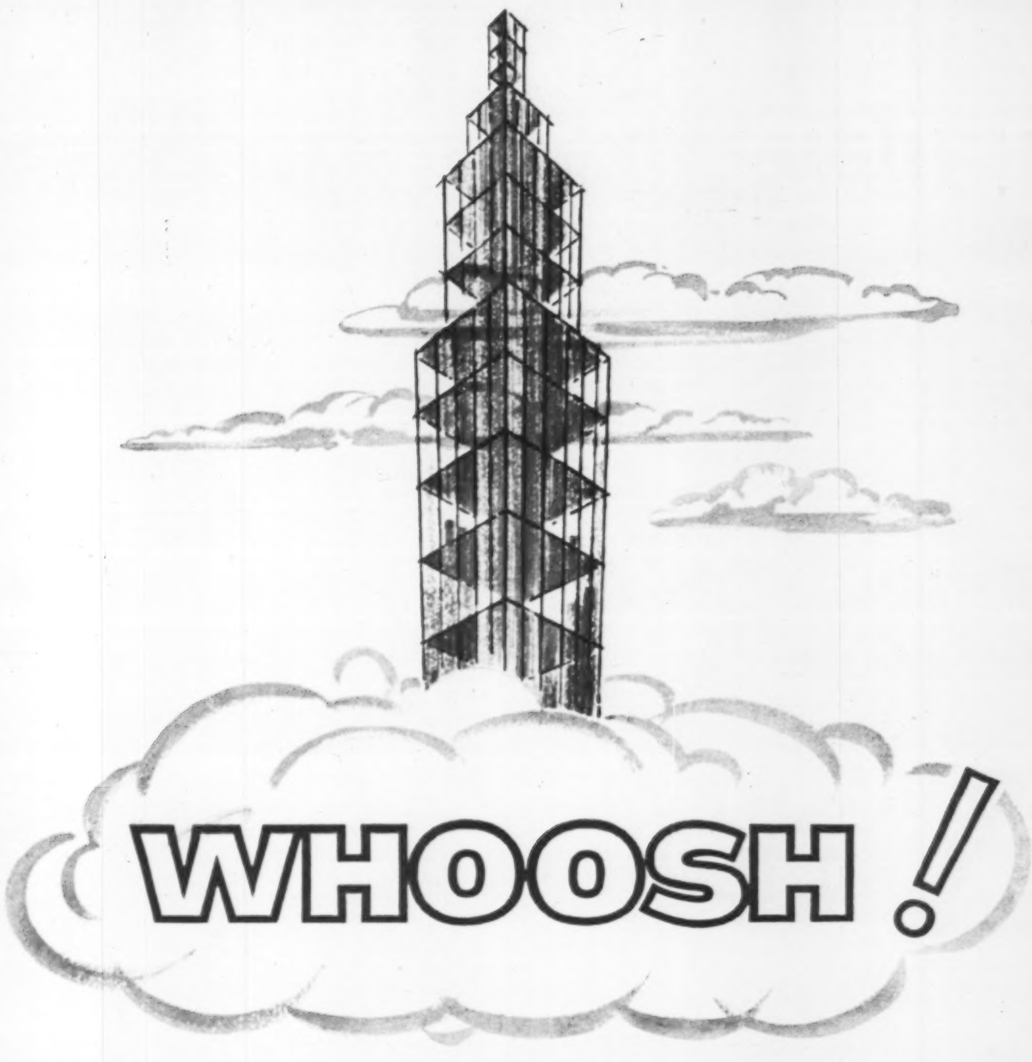

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Civil Engineering, July 1960, Vol. 30, No. 7 • Published monthly by the American Society of Civil Engineers. Publication office Concord, New Hampshire. (Second class mail privileges authorized at Concord, New Hampshire.)

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JULY 1960
VOL. 30 · NO. 7

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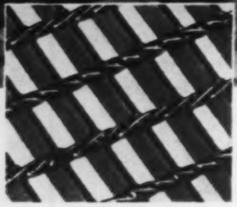

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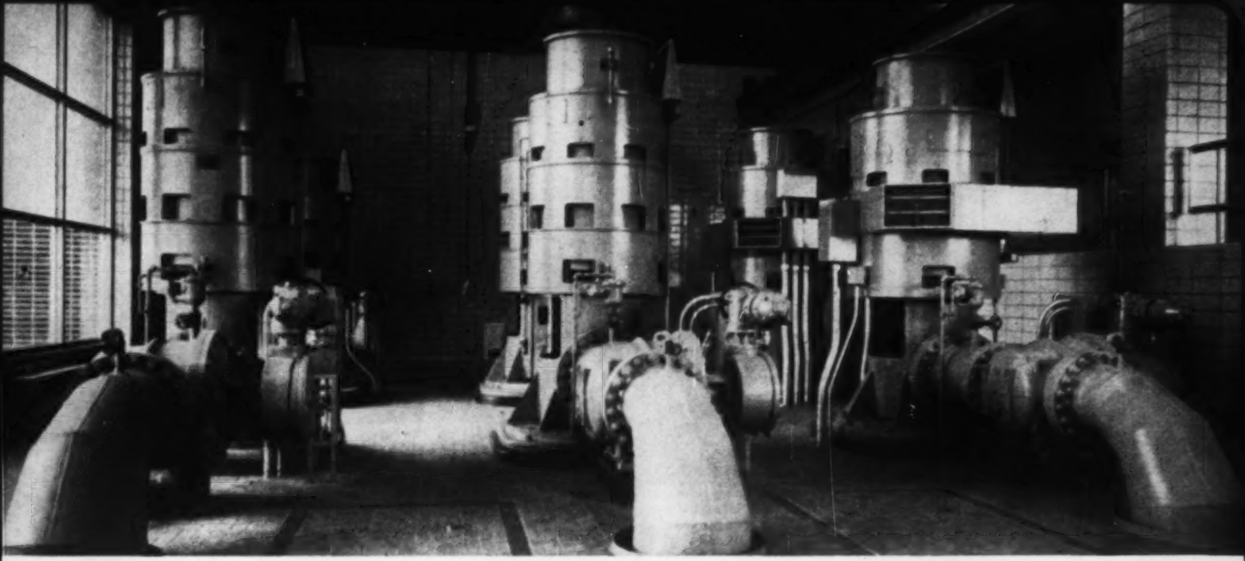

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Springfield, Ohio has a completely new, automatic water supply system by Layne. It guarantees 66 million gallons per day for their present and future needs—a job complete by Layne—and a completely satisfied customer. Field Tests exceeded the guaranteed pump efficiencies by 1% to 2% on all units. Consulting Engineers: Black and Veatch, Kansas City Missouri. Water Supply Contractors: The Layne Ohio Company, Columbus, Ohio. Do you need complete water service? Get it from Layne. Write for Bulletin 100.

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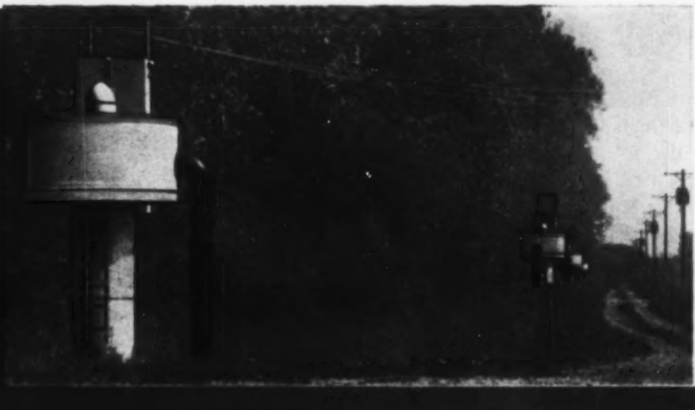

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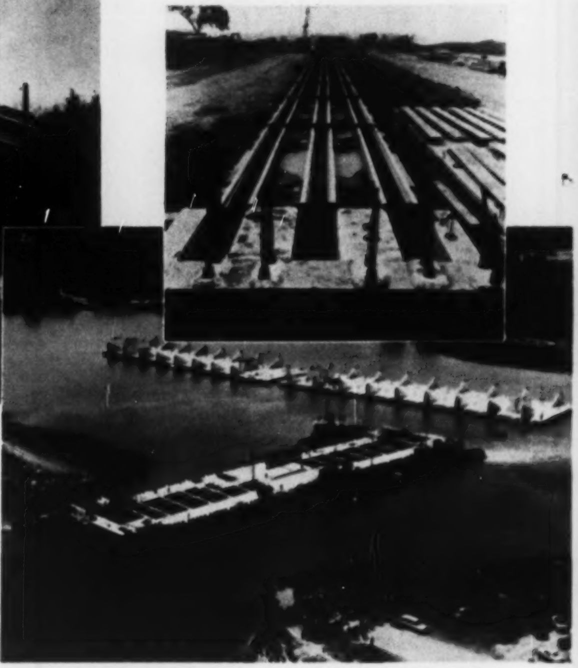
Sales Representatives in Major Cities

1950 Walnut Lane Bridge. America's first prestressed concrete girder bridge. Beams were cast-in-place and post-tensioned. Center span is 160 feet. Lehigh Portland Cement was used exclusively on this project, and on the Washington aqueduct bridge seen on opposite page. Lehigh Early Strength Cement was used in the manufacture of all other prestressed units on these two pages.

Over 3,000 prestressed concrete stringers for New York's Pier 57 were cast in these beds. This project is credited with proving the economy of off-job-site mass production of pretensioned concrete units in the U. S.



1952 The prestressed stringers for the main deck of Pier 57, as well as the huge box foundations shown above, were fabricated at West Haverstraw, N. Y. and then moved 38 miles down the Hudson River to the pier's present location.

From WALNUT LANE...

10 Years of Prestressed Concrete

Dedicated in the fall of 1950, Philadelphia's Walnut Lane Bridge is now recognized as the beginning of a major new industry in America—prestressed concrete.

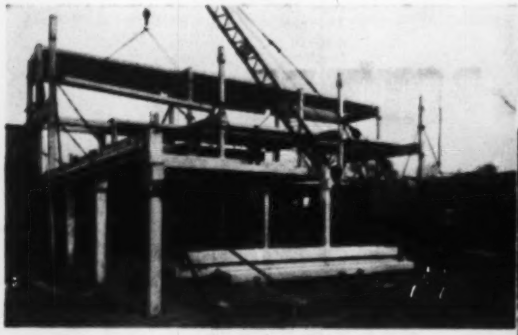
The phenomenal growth of the industry since Walnut Lane is ample proof of the foresight and ability of designers, fabricators and contractors who saw *and did something* about prestressed concrete's advantages. Results—concrete structural members of lighter weights . . . longer, straighter spans with characteristic graceful appearance . . . large column-free floor areas for buildings . . . fast job-site assembly . . . all augmented by the inherent fire resistance and low maintenance of concrete. The future? It's limited only by the imagination.

Lehigh played a significant part in the construction of the Walnut Lane Bridge. And in the 10 years since, Lehigh Cements have been used in hundreds of prestressed structures, a few of which are shown here. Lehigh Portland Cement Company, Allentown, Pa.

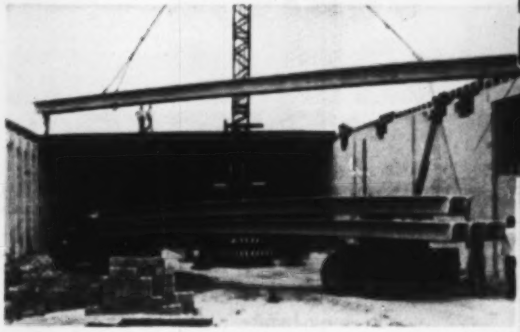
**LEHIGH
CEMENTS**

1954 The seven 120′ roof girders in Greensboro, N. C. High School Gym were at that time the longest prestressed concrete girders used in U. S. building construction.

1955 This is the first prestressed concrete highway bridge to be built in Kansas. It is located in Lincoln County.

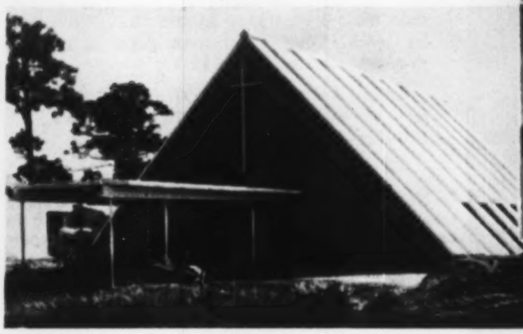


1956 Precast concrete columns support the prestressed beams, floor channels and roof channels of this 3-story addition to an industrial plant in St. Louis Park, Minn.

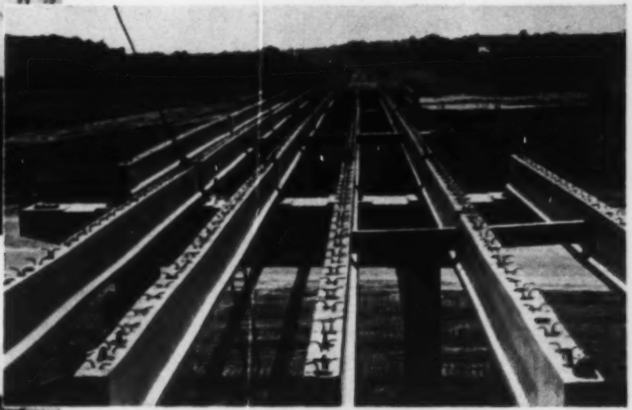


1957 Thirty-eight 60′ long prestressed double tee beams form the roof of part of this synagogue in Vineland, N. J.

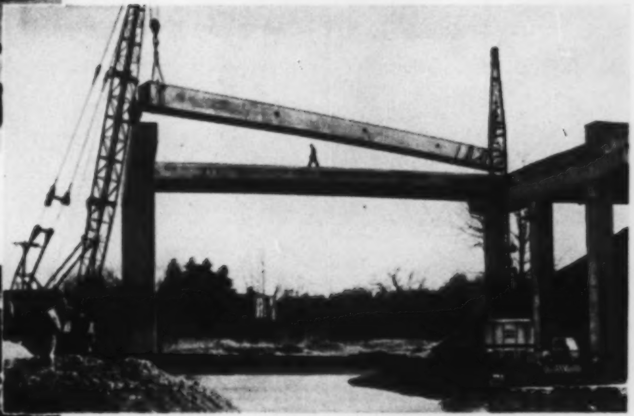
1958 This 216′ cast-in-place, post-tensioned Washington aqueduct bridge at Little Falls, Md. was, at the time of completion, the longest prestressed concrete span in the U. S.



1958 Just 38 prestressed slabs were required for the roof-walls of this unique church in Ft. Lauderdale, Fla.



1959 One of the thousands of prestressed bridges which will become a part of our new Interstate Highway system. This one is near Jackson, Tenn.



1959 Over 400 prestressed box beams up to 95′ long were required for seven bridges for U.S. Route 1 bypass around Media, Pa.

FORBES & WALLAC

1959 182 prestressed concrete single tee beams (54′ x 8′) provide a 3½-story post-free parking facility for Forbes & Wallace Department Store in Springfield, Mass.

DON'T BE FOOLED BY INITIAL PIPE COSTS...

Certain factors concerning the type of pipe to be used for a proposed water or gas project must be examined carefully:

First

—how much does the pipe cost, compared to other types?

Second

—how often will it require repair?

Third

—how long before it has to be replaced?

After all, how much money do you really save if you buy the cheapest pipe . . . then have to repair it frequently . . . and *then* have to replace it within a decade or two?

You save with cast iron pipe

Sometimes the first cost of jobs where cast iron pipe is specified, is higher than similar projects using cheaper pipe. Yet, in the long run, cast iron pipe costs *less!* Here's why:

- Cast iron pipe rarely requires repairs. Its rugged construction, corrosion-resistant qualities and bottle-tight rubber-ring joints will withstand the most severe pressures. Once an investment is made in cast iron pipe, it is usually your first and last cost because of the absence of maintenance or repairs.
- Cast iron pipe is built to *last*—98 American cities will testify to that. They've had cast iron pipe installations in constant use for over a century! In fact, in Versailles, France, they're still using cast iron pipe water mains that were laid in 1664! Once cast iron pipe is in the ground, it stays there!

Don't be fooled by "low-cost" pipe. Insist on the pipe that will actually save you money over a period of years . . .

In Nebraska—Here a section of cast iron pipe is being relocated. Twenty-five years old, the pipe is still in excellent condition—has never required major repair . . . or replacement.

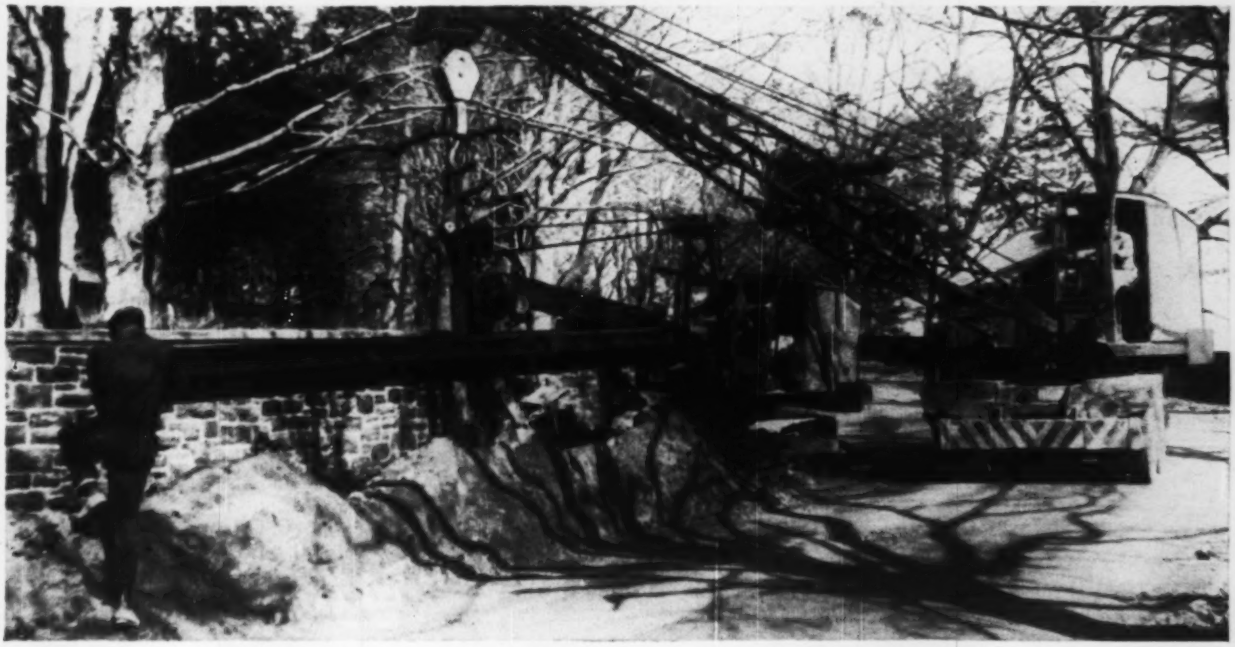
Rely on CAST IRON PIPE

In Indiana (above)—"All-weather" cast iron pipe is quickly installed despite wet trench conditions. Slip-on joints were easily assembled, with one workman using a crowbar.

In Kansas (above)—36" cast iron water main. Another part of this main was floated out of its trench by a heavy downpour. Later a 150 psi water test revealed no leaks in the slip-on joints!

In Pennsylvania (below)—This 16" cast iron pipe is being installed as fast as the trench hoe can prepare the trench.

Handy lengths and slip-on joints make cast iron pipe easy to handle, even in crowded neighborhood sectors; require less labor.



CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

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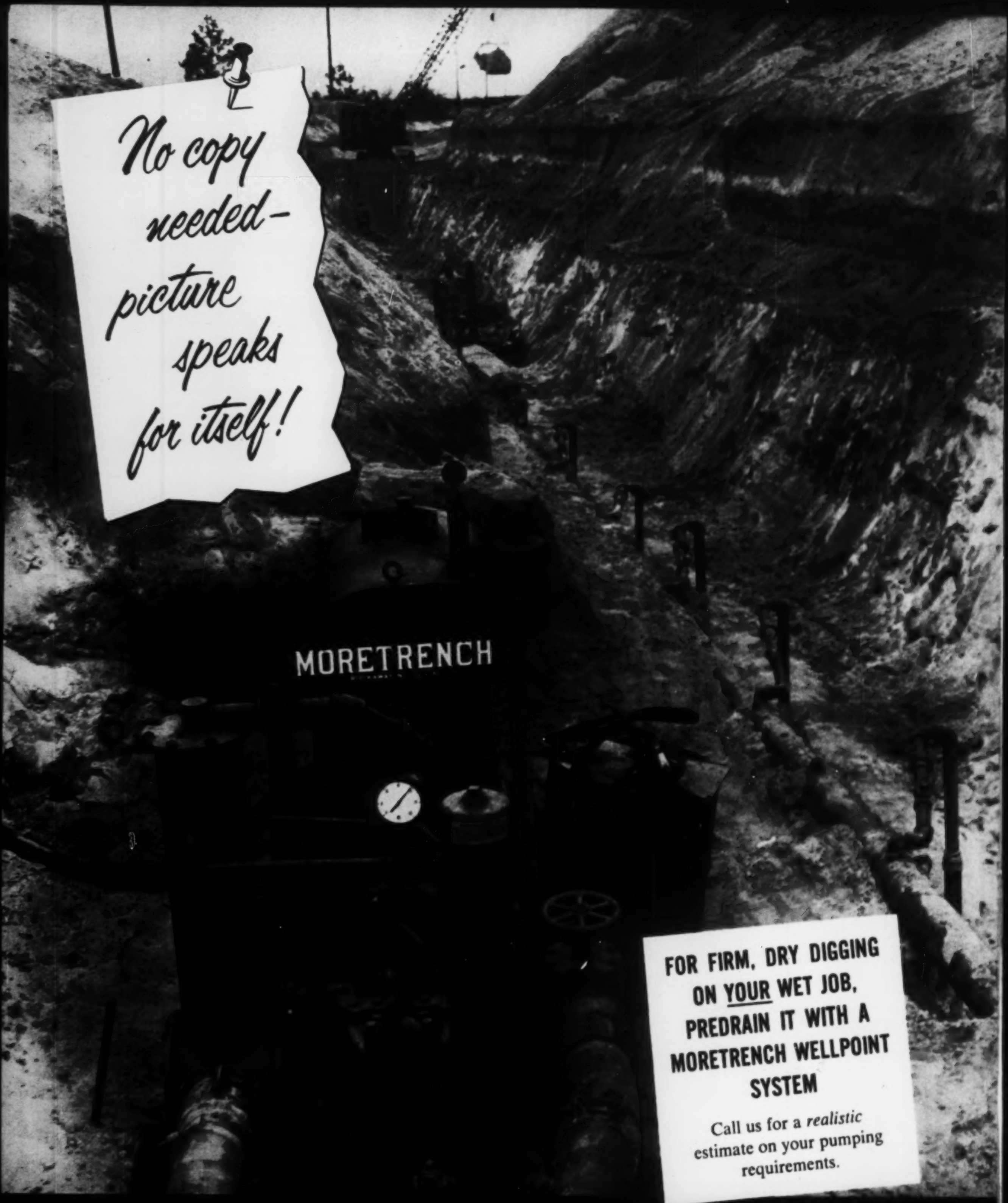

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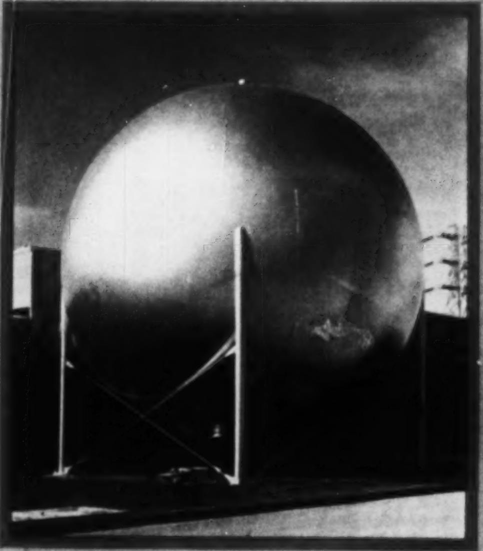
The flight of a ballistic missile entering the earth's atmosphere is simulated in an Atmosphere Entry Simulator built by the National Aeronautics and Space Administration at Ames Research Center, Moffett Field, California.

Employing the Ames Simulator, space scientists quickly and economically determine in the laboratory whether a specific design can survive re-entry.

CB&I fabricated and erected several vital components for this important research facility. Included are a 30½ ft. diameter steel vacuum sphere and a 10 ft. diameter duct and elbow.

Craftsmanship in Steel—skillfully developed by CB&I over more than seven decades—builds quality into plate structures for any kind of service. You will profit by contacting our nearest office for full details.



CB&I fabricated and erected steel vacuum sphere (left) and 10 ft. diameter duct and elbow (below, far right) for the Ames Atmosphere Entry Simulator.

EB&CB

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No Maintenance Problems Here...it's REINFORCED CONCRETE

Beckler River Bridge, Snoqualmie National Forest, Oregon
Designers: U. S. Department of Commerce, Bureau of Public Roads for U. S. Forest Service
Contractor: David Nygren, Seattle, Washington

With continuously rising costs plaguing our highway departments, economy minded officials are utilizing Reinforced Concrete for the construction of maintenance-free highway structures. Reinforced Concrete structures are resistant to the effects of extreme weather and temperature change, wind, shock, and quakes—never require painting or other refurbishment.

They are lower in first costs, too! Reinforced Concrete highway projects start on time and finish on schedule without expensive delays due to material shortages or field changes. And, all materials and labor are readily available from local sources.

If rising maintenance and construction costs are delaying your highway projects, design your structures for Reinforced Concrete and enjoy its many costsaving and timesaving advantages.

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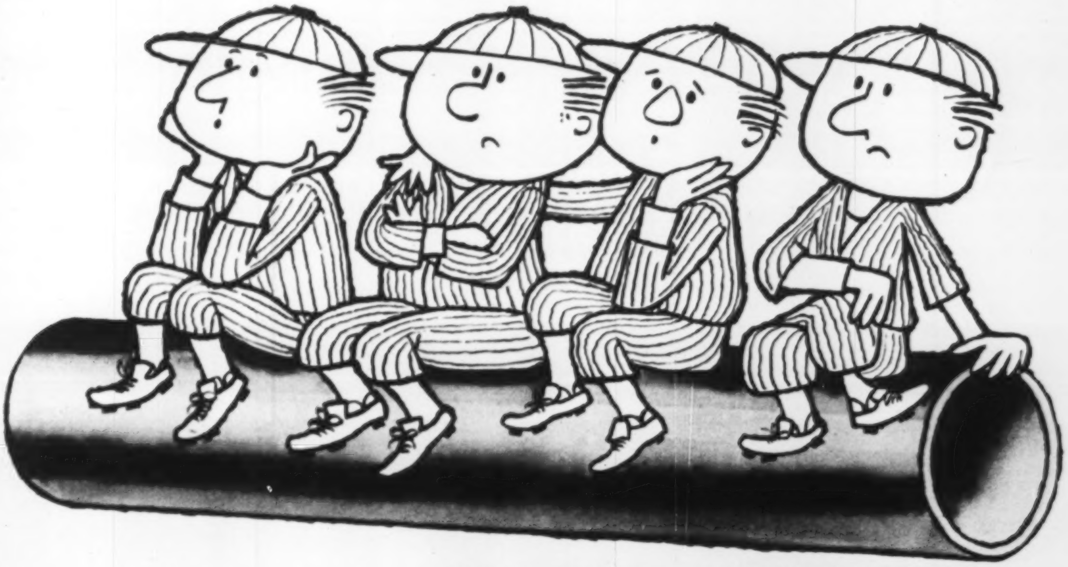

no place for SUBSTITUTES in pipe selection

Check the score before experimenting with substitutes for cast iron pipe!

POINTS TO COMPARE	CAST IRON PIPE	SUBSTITUTE PIPE
Long Life	100 Years or more	?
Bursting Pressure	2,988 psi	746 psi
Bursting Tensile	25,880 psi	3,430 psi
Impact Resistance	234 ft. lbs.	60 ft. lbs.
Beam Loads (12-foot span)	20,790 pounds	3,060 pounds
Crushing Loads	17,900 lbs. per ft.	6,480 lbs. per ft.
Water Absorption	None	9.8% of weight after 24-hour submersion
Tight Joints	Wide selection for liquid or gas service	Limited selection for water service
Inside Diameter	6.14"	5.85"

Pipe tested were 6" Class 150.

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On Erie Thruway twin bridges—

USS MAN-TEN High Strength Steel

USS MAN-TEN Brand High Strength Steel was used for the highly stressed members of these two bridges, including many of the upper and lower chords, diagonals, verticals and gusset plates. Bridge owner: Pennsylvania Department of Highways. Designer: Richardson, Gordon & Associates, Pittsburgh. General Contractor: Brayman Construction Co., Pittsburgh. Erector and Fabricator: The Levinson Steel Co., Pittsburgh.

saves weight and cuts costs

The use of high strength steel as a means of saving weight and reducing costs in bridges is rapidly gaining favor. These twin bridges across Six Mile Creek on the Erie Thruway, 15 miles east of Erie, Pennsylvania, were built with 600 tons of USS MAN-TEN Brand High Strength Steel to ASTM specification A-440 and 1,200 tons of ASTM A-7 Steel.

High strength steel was used for heavily stressed members where its higher allowable stress value and weight savings made it more economical. The design stress in bridges for USS MAN-TEN Steel is usually 24,000 psi compared to 18,000 psi for ASTM A-7 Steel. The members shown in color in the diagram were made of USS MAN-TEN High Strength Steel. In addition, many of the gusset plates were MAN-TEN Steel.

Weight savings: USS MAN-TEN (A-440) Steel fully meets all the requirements of the new ASTM specification A-440. When full advantage of its higher yield point—50% greater than structural carbon steel—is utilized, it allows the engineer to design with smaller sections than would be normally used—and thereby realize weight savings up to 25%. A cost savings is also possible, since anywhere USS MAN-TEN Steel accomplishes a weight reduction over 16%, it then becomes the more economical steel to use.

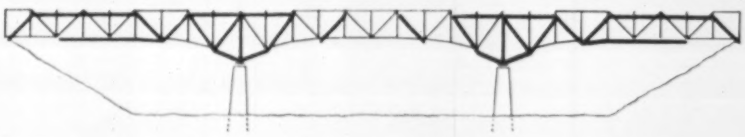
Other USS High Strength Steels available for construction include USS TRI-TEN and USS COR-TEN Steels. Like USS MAN-TEN Steel, these grades have a minimum yield point of 50,000 psi and offer the same weight and a potential cost savings. USS TRI-TEN Steel particularly is recommended for welded structures, while USS COR-TEN Steel, because of its outstanding resistance to atmospheric corrosion and superior paint adherence qualities, is a "natural" for bolted or riveted structures where maintenance is a problem.

Where an extra high yield strength steel is needed, USS "T-1" Constructional Alloy Steel combines weldability and toughness with 100,000 psi minimum yield strength.

For complete information on any of these steels, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS Steels for Bridge Design

Structural Carbon Steel 33,000 psi minimum yield point	**USS MAN-TEN High Strength Steel** 50,000 psi minimum yield point
USS TRI-TEN High Strength Steel 50,000 psi minimum yield point	**USS "T-1" Constructional Alloy Steel** 100,000 psi minimum yield strength



Where high strength steel saved money. 'Profile of one of the two bridges showing members made of USS MAN-TEN Steel where its high strength/weight ratio made it economical to use.

USS, MAN-TEN, COR-TEN, TRI-TEN and "T-1" are registered trademarks

This mark tells you a product is made of modern Steel

Steel

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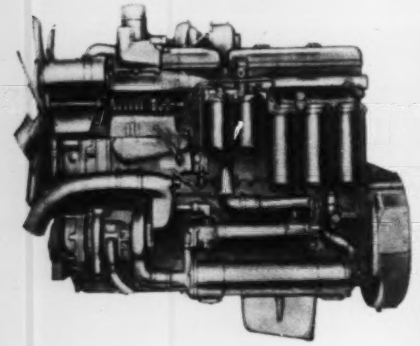
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Supply—Steel Service Centers
United States Steel Export Company
United States Steel

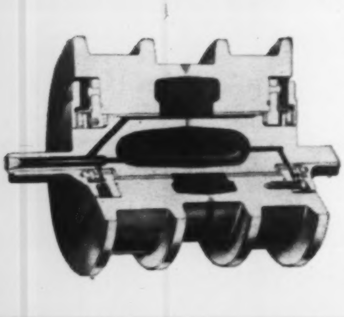
USS

Three new International TD-25's of contractor V. E. Posey's fleet team up preparing home sites from a mountainside... near San Diego, California. One "25" operator comments: "The power is there, but big engine 'sound and fury' are just about gone!"



Big power "plus" of the new TD-25 is the new direct-start, 6-cylinder turbocharged International DT-817 diesel engine. Tri-metal crankshaft bearings; valve rotators; dry-type air cleaner; externally-mounted, gear-driven oil and water pumps—all are typical DT-817 long-life, high-output features!

How you get full-



Thick-shelled International Dura-Rollers have king-sized lube reservoirs, positive sealing, and exclusive relief-passage protection from over-lubrication. These *minimum maintenance* track rollers give you practical 1,000-hour lubrication intervals!

Keep full loads on the move full time with exclusive Planet Power-steering. Full power on both tracks, full time, is the answer! And Hi-Lo on-the-go power-shifting lets you match power to condition, instantly, to keep loads "on the move"—and increase speed where practical! This "25" belongs to Berke Moore Co., Inc., Boston expressway contractor!

load turns...full-speed cycles

with proved TD-25 standard equipment!

As standard equipment at no extra cost, the new 230-hp TD-25 gives you the International® proved control combination that has been outproducing king-sized clutch-steered crawlers for years!

You get combined Planet Power-steering and Hi-Lo on-the-go, power-shifting exclusively in the new International TD-25. And you get this basic, built-in design advantage in your choice of torque-converter or synchromesh model!

With this and all its other big advantages, the TD-25 can outearn other big rigs up to 50%—on push-loading, bulldozing, or pulling big drawbar tools such as a shale-shattering ripper!

No "dead-track drag" or "gear-shift lag"!

Planet Power-steering gives you full-time "live" power and traction on both tracks, to make full-load turns—and to eliminate load-limiting "dead-track drag." And Hi-Lo on-the-go power-shifting instantly matches power to conditions to end load-losing "gear-shift lag."

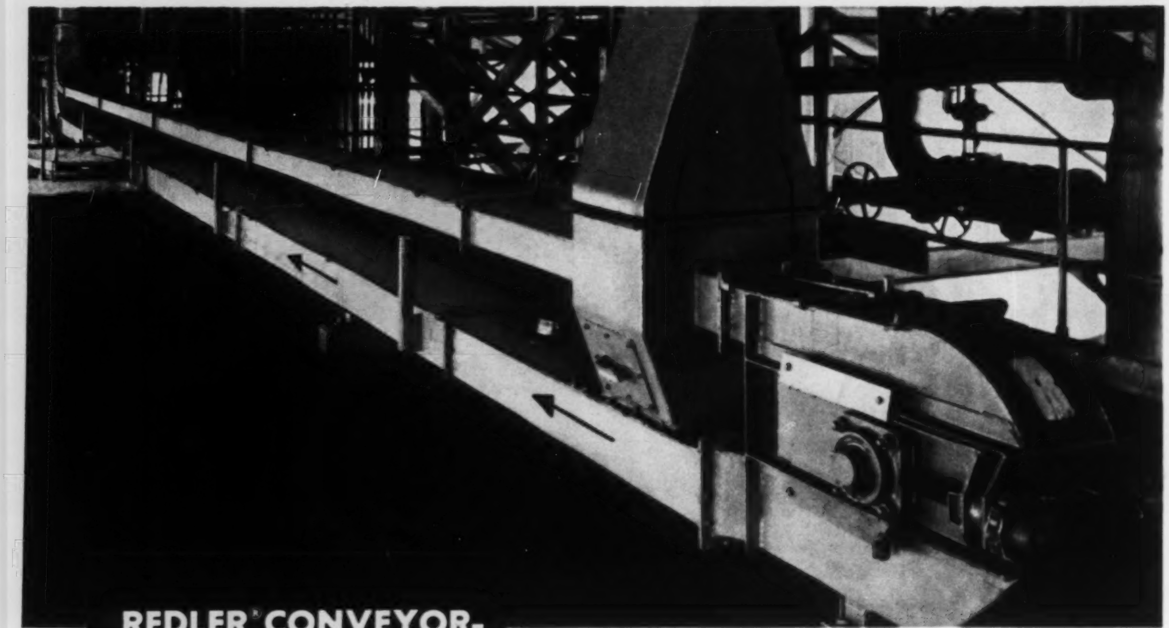
Hi-Lo power-shifting makes the TD-25 the industry's only king-sized 4-speed torque-converter crawler, and the only one with load-matching efficiency-range control. In the synchromesh transmission "25," the Hi-Lo planetary system gives eight speeds forward and reverse. Either model gives you cycle-speeding, up-or-down, on-the-go power-shifting with "finger-tip" ease!

Power-shift and power-steer the new "25" with king-size loads—around curves, upgrade, anywhere. Prove what it means to command full-time, full-load ability to outearn clutch-steered king-sized crawlers, up to 50%—and with standard control equipment! Compare simplified TD-25 design—the only planetary system engineered and located to give you "live track" power steering and on-the-go, up-or-down power shifting! See your International Construction Equipment Distributor for a demonstration!

International® Construction Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE

STEPHENS-ADAMSON

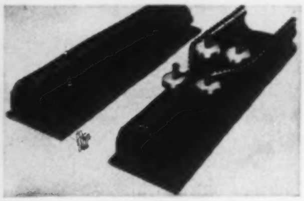


REDLER CONVEYOR-ELEVATORS SPEED EFFICIENCY, LOWER BULK CHEMICAL HANDLING COST

S-A REDLER Conveyor-Elevators have been in successful operation for over 25 years, with well over 20,000 units now handling a wide range of pulverized, granular, small lump and flaked materials, in plants throughout the world. The REDLER Conveyor-Elevator moves material by an EN MASSE action horizontally, vertically, on inclines, or around bend corners. All movement is continuous and takes place within totally enclosed, dust-tight, compact casings, permitting large tonnages to be handled in small space. The conveying element is a series of U-type skeleton flights which move readily around sprockets and bend corners with relatively low power required at the drive. Skeleton flights may easily be unhooked and replaced without tools. Handles up to hundreds of tons per hour and provides maximum versatility to handle hundreds of bulk chemical materials.

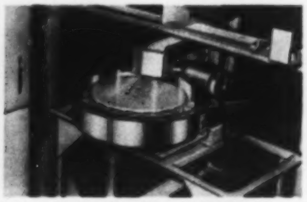
S-A ENGINEERED PRODUCTS FOR CHEMICAL HANDLING SYSTEMS

Cutaway Section REDLER Conveyor-Elevator shows skeleton flights loaded and unloaded.



"ZIPPER" CLOSED-BELT CONVEYOR-ELEVATOR—BULLETIN 349

BELT CONVEYORS—REQUEST CATALOG DATA



CONTINUOUS WEIGHER—BULLETIN 958

WRITE
FOR
BULLETIN
358

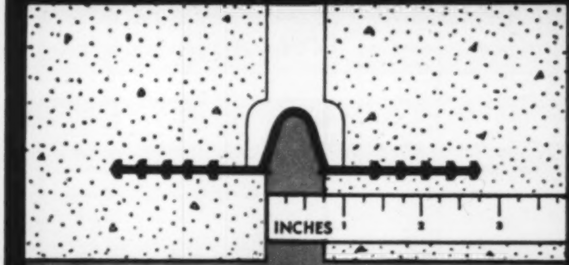
S-A
ENGINEERED BULK HANDLING SYSTEMS
MATERIALS HANDLING PRODUCTS
SPEEDWALK PASSENGER CONVEYORS
SEALMASTER BALL BEARING UNITS
SPHERCO BEARINGS & ROD ENDS

ENGINEERING DIVISION
STEPHENS-ADAMSON MFG. CO.
GENERAL OFFICE & MAIN PLANT, 66 RIDGEWAY AVENUE, AURORA, ILLINOIS

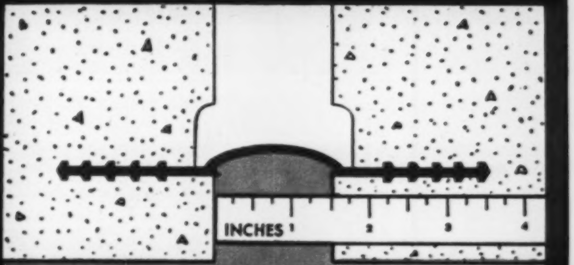
PLANTS LOCATED IN: LOS ANGELES, CALIFORNIA • CLARKSDALE, MISSISSIPPI
BELLEVILLE, ONTARIO

NOW . . . A WATERSTOP DESIGNED TO HANDLE ELONGATION CORRECTLY . . . WITHOUT STRESSING THE MATERIAL OR MULTIPLE-RIB AREA!

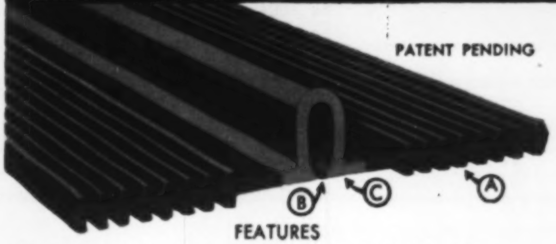
SEALTIGHT®



Notice how the U-Bulb design permits the waterstop to mechanically expand without stretching the material or stressing the multiple-rib area. The DUO-PVC material maintains correct thickness and the ribs remain firmly embedded in the concrete to stop water.



During tests conducted at the University of Detroit the joint was opened 1½" and the DUO-PVC waterstop was subjected to a 100 foot head of water . . . *no leakage occurred* . . . also a 215 foot head of water was applied . . . again *no leakage occurred.* Tests also proved tremendous advantage of the exclusive Sealtight rib design. Copies of test results available on request.



FEATURES

- Ⓐ Exclusive rib design offers greater holding power, strength and rigidity. The rigid ribs will not compress, shear-off or pull-out.
- Ⓑ Exclusive thin membrane prevents infiltration of concrete during pouring . . . designed to tear under expansion and allow U-bulb to accommodate extreme expansion.
- Ⓒ Exclusive U-bulb design mechanically expands 1½" without stretching material or stressing rib area . . . when greater expansion occurs the DUO-PVC material will then accommodate it safely.

. . . the first waterstop designed to accommodate expansion without impairing the basic function of the waterstop!

Sealtight DUO-PVC Waterstops are simultaneously extruded from two top-quality PVC compounds. The PVC utilized in the center area is compounded to combine strength with maximum flexibility, whereas, the multiple-rib area is extruded from a PVC compound that offers great strength with a desirable rigidity. This new concept of waterstop design permits DUO-PVC Waterstops to effectively function as a waterstop while safely accommodating expansion movements heretofore thought impossible. Mail the coupon below for complete information.

Another important technical advancement from the Research and Development Department of W. R. Meadows, Inc.

SEALTIGHT®

PRODUCTS
FOR BETTER
CONSTRUCTION

W. R. MEADOWS, INC.
20 KIMBALL ST. ● ELGIN, ILLINOIS

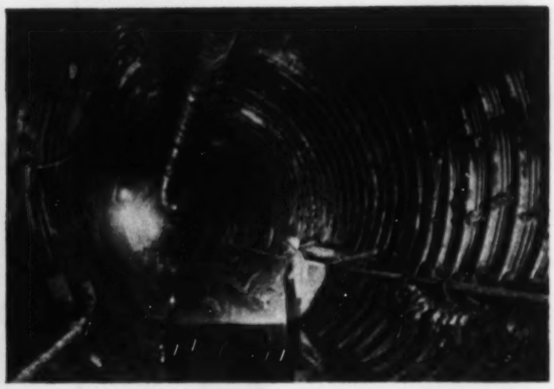
Please send without obligation information on the new Sealtight DUO-PVC Waterstops.

Name______________________________

Address______________________________

City____________________Zone_____State__________

18½ ft. tunnel portal—Terrain shows tunneling conditions encountered.



Plates installed quickly—Necessary for immediate ground support. All bolting is in the open through inside flanges—note staggered joints.

Interior of 9½ ft. tunnel—COMMERCIAL tapered plates provide contiguous lining at lateral curves.

How Liner Plates Lick Mud, Water, 60-Ton Boulders!

The scene: Bull Run Dam Project, Sandy, Oregon. Tunnel Contractor: Gates & Fox Company, Burlingame, California. Tunnel Project Engineer: Mr. E. M. Woodward.

The problem: Two 1,720 ft. tunnels had to be dug to create dry site for building of dam. One diversion tunnel to be 18½ ft. in diameter; the other, a water supply tunnel, 9½ ft. in diameter with 3 lateral curves. Tunnels were 80 to 100 ft. beneath surface of semi-liquid, rhombohedron earth, liberally salted with angular, 100 lb. to 60 ton basaltic boulders. Areas of high-point pressure loading from unsupported rock and overflow from an underground lake further complicated matters.

The solution: The 18½ ft. tunnel was supported by 15,000 COMMERCIAL 5/16" thick liner plates. Each course consisted of 18 full plates 16" x 37½" and 1 half plate 16" x 18¾" to form a complete circle. The 9½ ft. tunnel took 13,000 plates 3/16" thick (9 full and 1 half plate) similarly arranged and, where necessary, tapered to fit 3 lateral tunnel curves. All courses were mined in with staggered joints so no continuous longitudinal seam ran farther than the 16" plate width.

Plates in both tunnels were pierced with 2" grout holes to allow gravel-cement fill outside liner. Well bundled COMMERCIAL liners handled well and fit perfectly, aiding in progress of 12 ft. per 24 hours in large tunnel, 20 ft. per 24 hours in smaller tunnel.

Technical service backs the product: According to Project Engineer E. M. Woodward, "COMMERCIAL SHEARING provides excellent service, superior product design and on-the-spot engineering help for tough situations. They proved they're not the kind of firm to just ship the plates and forget the project . . . their service was both impressive and expert!"

For complete details on how COMMERCIAL steel liner plates can simplify and speed up your vertical shaft, surface or sub-surface tunnel project—help make it safer—send today for your copy of Catalog 300-C2. Write to Commercial Shearing & Stamping Co., Dept. C-27, Youngstown, Ohio.

COMMERCIAL
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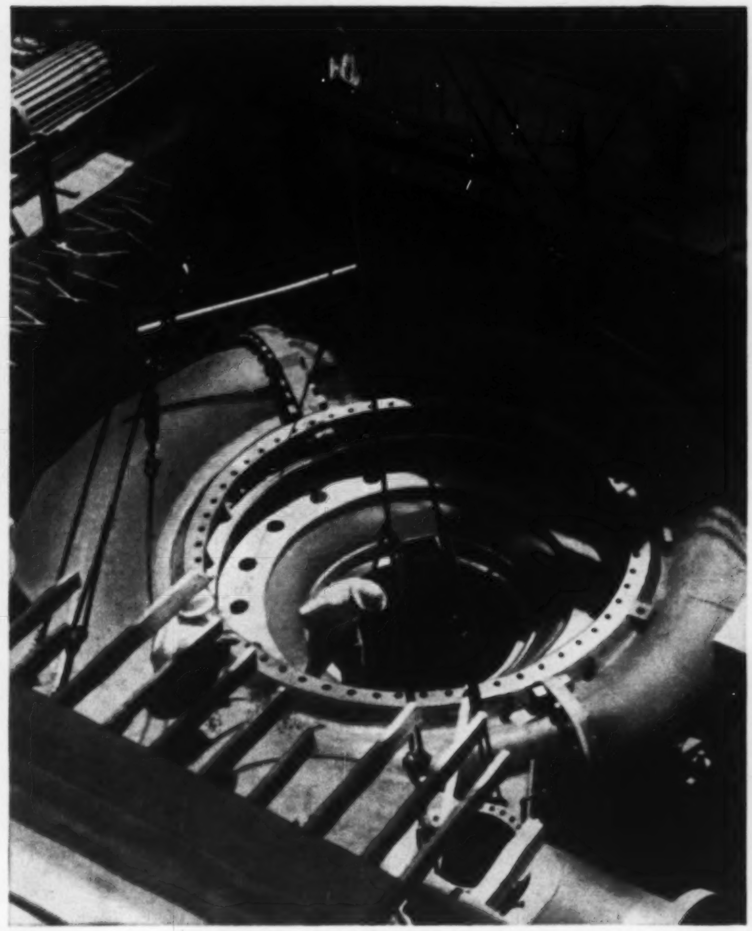
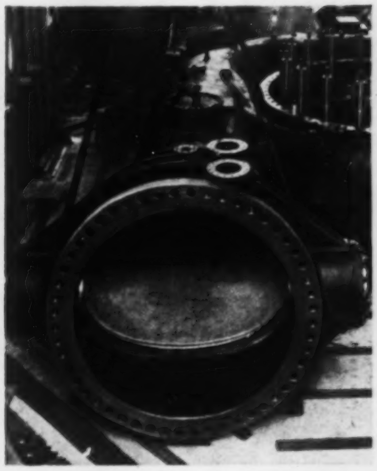
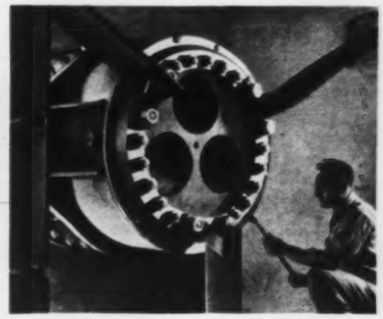
ALLIS-CHALMERS



Spiral case for one of the two A-C Francis turbines at Mammoth Pool (each rated 88,000 hp under 950-ft head at 360 rpm).



Butterfly-type turbine inlet valves—designed for minimum head loss, are bolted directly to 69 inch diameter spiral case inlet flange.



HOWELL-BUNGER valve for pressure relief — one of two 36-inch Allis-Chalmers pressure-regulator valves at Mammoth Pool, in operation under heads exceeding 1000 feet.

Peaking capacity using high-head hydro

...boosts coast utility hydro past the million-kw mark

Two Allis-Chalmers hydraulic turbines installed by Southern California Edison Company at the new Mammoth Pool project operate under a maximum gross head of 1100 feet. After careful consideration of the relative merits of Francis and impulse-type turbines, the Francis type was selected for this high-head installation. Operation of these units as "spinning reserve" required special care in design and manufacture to minimize leakage losses.

Corrosion-resistant wearing plates and gates are precision machined to permit total gate end clearances at assembly of minus nothing to plus 3/1000 of an inch.

Cooling water is piped to the runner seal rings and a complete tailwater depressing system was included by A-C. To facilitate 10-second load rejection and maintenance of minimum downstream flows, A-C supplied two *Howell-Bunger*, free-discharge type, pressure-regulating valves. Two special high head 90-inch butterfly-type inlet valves are provided with corrosion-resistant seals and seat rings adjustable from the outside. A 60-inch *Howell-Bunger* valve and a 72-inch butterfly guard valve are in the reservoir dam outlet works for water release when required.

Look to Allis-Chalmers for engineering, design and manufacture of hydraulic turbines and accessories. *Contact your local A-C office for information or write* **Allis-Chalmers,** ***Hydraulic Division, York, Pa.*** A-1333

Howell-Bunger is an Allis-Chalmers trademark.

BEST TRACK...
BIGGEST SAVINGS

Allis-Chalmers boosts work hours, cuts costs with the best tractor undercarriage in the business. You get industry's toughest track...best designed track guards ...certified, permanently lubricated truck wheels, idlers, support rollers.

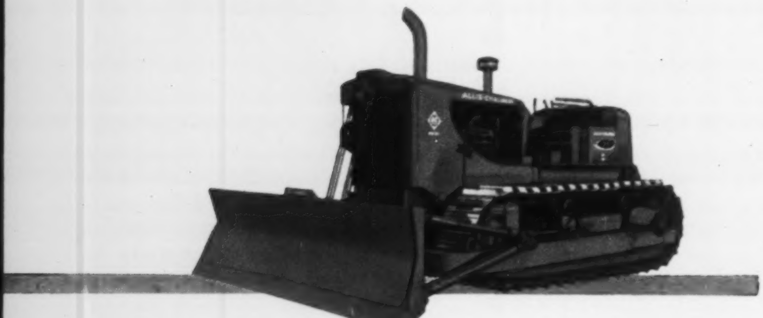
Next time you watch track shoes squeal and grind against jagged rock . . . or see 'em buried sprocket-deep in mud, consider this: Nothing slugs it out with tough conditions like an Allis-Chalmers tractor undercarriage.

Specially heat-treated track shoes, side bars, track pins and bushings are the industry's toughest. Bushings extend into counterbored side bars to seal out dirt, provide more bearing area.

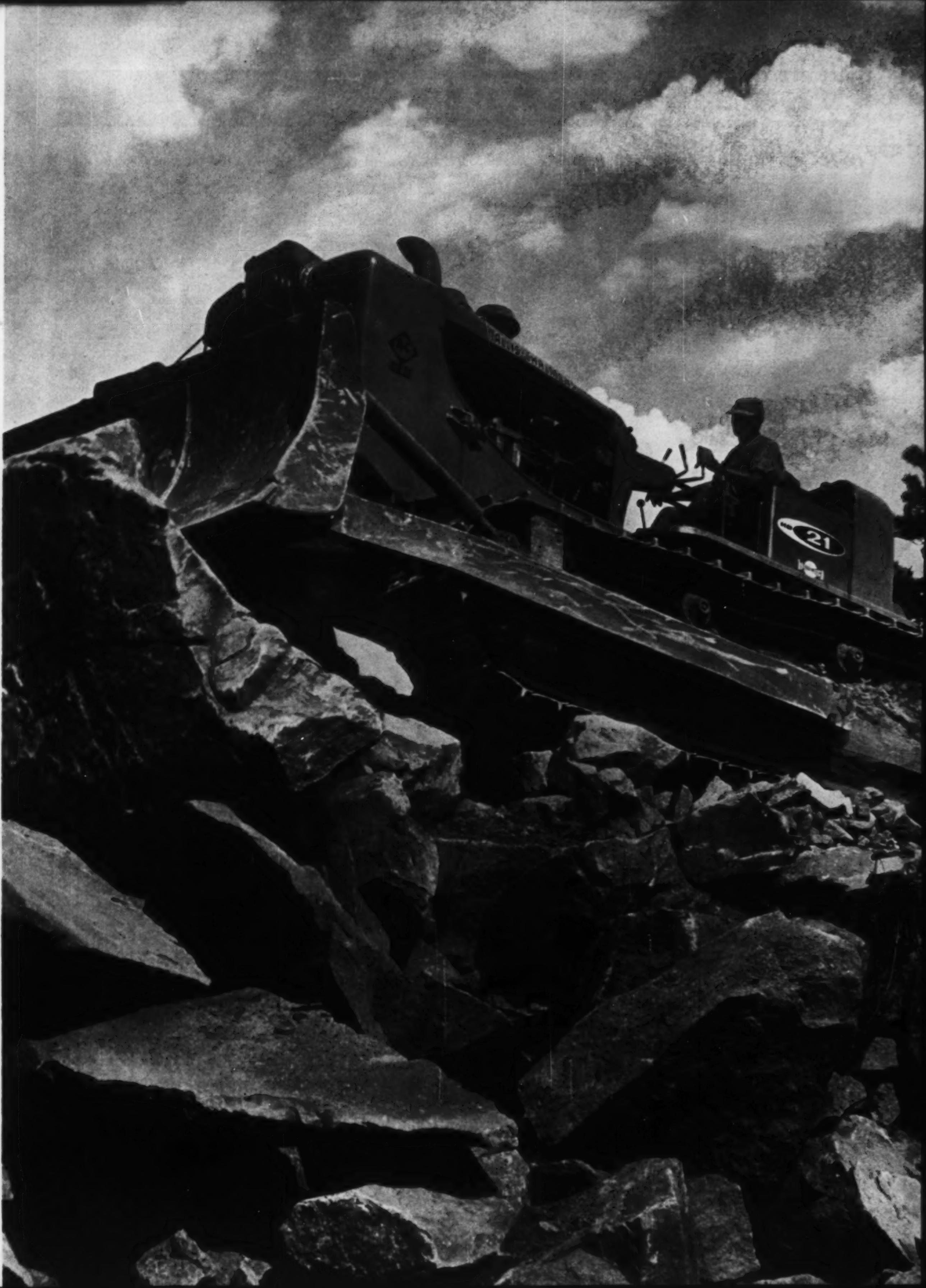
Track guiding truck wheel guards provide a deep-flanged guide channel that keeps track riding true on sprockets, idlers and truck wheels even in the roughest and toughest going. The solid A-frame holds the truck frames in absolute alignment — keeps track running straight.

PERMA-SAFE truck wheels, idlers and support rollers on all Allis-Chalmers tractors roll on tapered roller bearings, are protected against dirt and moisture by Positive Seals. Factory-lubricated, they're certified never to need further greasing.

We invite a maintenance cost comparison with any other tractor undercarriage. We further invite you to inspect the Allis-Chalmers healthy, long-lived tractor engine, the all-steel main frame, double-reduction final drives and many other cost-cutting features. Your Allis-Chalmers dealer will be happy to give you full details. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.



move ahead with
ALLIS-CHALMERS
power for a growing world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NEWS OF MEMBERS

Charles C. Whittelsey received the honorary degree of Doctor of Engineering from his alma mater, the School of Mines and Metallurgy of the University of Missouri, on May 29. Mr. Whittelsey has been president of the New York consulting firm of Ford, Bacon & Davis since 1957, and is a director of the Southern Natural Gas Company, the West Coast Transmission Company, Ltd., the Southern Hardware Company, and Northwest Nitro-Chemicals, Ltd.

Joseph Hnot, Jr., since 1948 a staff member of the Standard Oil Company, is now head engineer, assigned to the design engineering division, in the general engineering department of the Company at Whiting, Ind.

Henry G. Schlitt, former deputy Nebraska state engineer, is now vice-president and general manager of the Lincoln (Nebr.) Sand and Gravel Company. Mr. Schlitt took over his new duties last month.

Peter A. Zahorik, after 37 years in the Milwaukee, Wis., office of the Bethlehem Steel Company, retired on May 1 as district engineer and sales engineer in building products.

Francis S. Friel, Past President of ASCE and a well-known Philadelphia consultant, received the George Warren Fuller Award of the Pennsylvania Section of the American Water Works Association at a special "Water Man of the Year" ceremony held in connection with the Association's 80th annual conference. At the same time, **Hugh W. Hetzer,** engineer in the design and construction department of the Union Carbide Chemicals Company, received the equivalent award of the AWWA's West Virginia Section.

Francis S. Friel

Hugh W. Hetzer

Tulon Lamar Jackson, Captain, Navy Civil Engineer Corps, has been ordered to the staff of the Chief Naval Air Training Center at the Naval Air Station, Pensacola, Fla. At present Captain Jackson is director of base development in the Logistics Division of NATO's Supreme Allied Commander Atlantic (SACLANT), in Norfolk, Va., and previously served on the staff of the Commander in Chief, U.S. Naval Forces Europe, with headquarters in London.

Gordon P. Fisher, a specialist in structural engineering and member of the Cornell University civil engineering faculty, has been appointed associate dean of the College of Engineering. For the past three years Professor Fisher, as consultant on a large atomic power plant now under construction, has been engaged in the relatively unexplored field of the analysis and design of containment structures for nuclear power reactors.

(Continued on page 26)

NOW
LOW-COST AUTOMATIC
FLOW RECORDING

Directly Readable Flow Charts

Obtain graphic records of liquid flow directly readable in million gallons per day or gallons per minute over various sizes of Parshall flumes. The same recorder can also be used with charts reading in feet and hundredths to record head or surface fluctuations in lakes, streams, wells. Write for free Bulletin 24.

STEVENS
TYPE F RECORDER

...For Measuring Sewage, Industrial Waste and Other Flows

The planning and efficient operation of any project which involves measurements of flowing liquids is based on flow data which can be obtained with STEVENS Recorders. These instruments are at work compiling data on hydroelectric and flood control projects and in water works, sewage disposal plants, irrigation and industrial installations in all parts of the world.

Experienced technical staff available to supply product information for liquid measurement installations. Write, giving description of project and scope of data desired.

HYDROGRAPHIC DATA BOO
invaluable for your reference file
124 pages of technical data on recorde nstallations, plus a wealth of hydraul ables and conversion tables. $1 copy (No COD's.)

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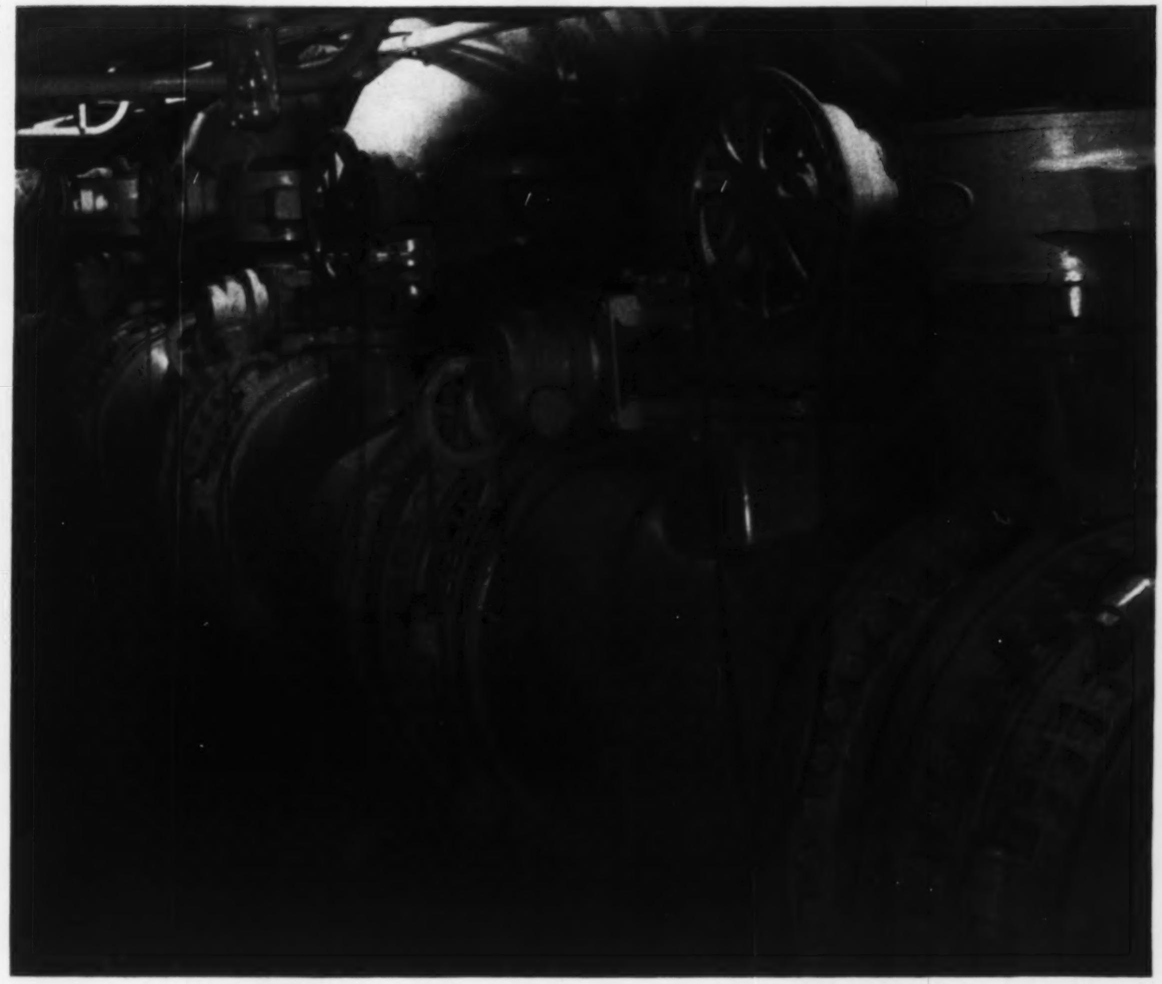
ALLIS-CHALMERS A-C ALLIS CHALMERS



One of the compact groups of A-C rubber-seated butterfly valves at the pumping station of a southwestern municipality.

The right valve "repeats itself"

66 Allis-Chalmers rubber-seated butterfly valves line up to prove it

Economical, dependable, easy to operate: Allis-Chalmers rubber-seated butterfly valves give you these and so many more advantages that it's easy to appreciate their universal popularity. Full body protection is provided by a rubber seat which extends through the valve body and over the flange faces. Angle seating protects the rubber seat and permits seating adjustment without costly disassembly.

A-C manufactures a complete line of metal and rubber-seated butterfly valves in a wide range of types and sizes in order to provide the best valve for a given application. Compact design joins with light weight to bring other savings in both space and cost of construction.

• • •

For details on butterfly valves, cone valves and ball valves, contact your A-C representative or write **Allis-Chalmers,** *Hydraulic Division, York, Pa.* A-1309

TIDE GATES

Figure B-175. Type M-R Gates designed especially for application to centrifugal pump discharge lines. A rubber seating ring is inserted in the seat to absorb the slap which occurs when pumps stop. A flexible bar connection is arranged between the hinge links to provide a stop for the gate shutter to prevent the outer edge of the shutter from tipping downwardly when flow abruptly ceases. Smaller sizes of gate are provided with a bumper arrangement to prevent the shutter being forced too widely open when flow starts.

Ask for Bulletin 73A

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LIMA, OHIO, U. S. A.

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The World's Finest
Low-Cost
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IF IT'S A CONCRETE TESTER
YOU NEED-GET IN TOUCH WITH

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P. O. BOX 310 · NEW CASTLE, PA.

News of Members

(Continued from page 24)

Allen Wagner, one-time director of ASCE public relations, has been elected vice-president of public relations by the board of directors of General Foods. Mr. Wagner joined General Foods early in 1958, becoming public relations manager in December of that year and director of public relations last October. A newspaper man whose professional experience dates back to 1921, he has been in public relations work since 1933.

Mark K. Wilson, Jr., civic leader and building contractor of Chattanooga, Tenn., recently received a citation from the Chattanooga Speakers Club for outstanding contributions for improving human relations in the area. Mr. Wilson's firm, the Mark K. Wilson Company, has erected some of the city's most important structures.

Richard W. Young, a recent addition to the General Electric staff, has been appointed resident engineer for the construction of GE's new manufacturing and processes laboratory in Schenectady, N. Y. A 1954 graduate of the Drexel Institute of Technology, he has been employed as field engineer with the Wigton-Abbott Corporation and as project manager with the C. G. Flygare Company.

George L. Hoffman, Lieutenant Commander, Civil Engineer Corps, U. S. Navy, is now assistant Caribbean area public works officer for design. He was previously stationed in the Bureau of Naval Personnel, Washington, D. C., as manager of the "CB" reserve training program.

Alphonse M. Westenhoff and **David Novick** announce the formation of Westenhoff & Novick, Inc., at 234 South Wabash Avenue, Chicago, Ill., for the practice of structural, foundation, and civil engineering.

Mahendra Raj has joined with **Rasvihari N. Vakil** to form the firm of Raj & Vakil in Bombay, India. A former executive engineer in the Punjab Public Works Department, Mr. Raj worked for Ammann & Whitney, of New York City, for nearly three years. Later, he was associated with LeCorbusier on the construction of the new capital for the State of Punjab. Dr. Vakil during a recent stay in the United States taught at the University of Wisconsin, Columbia University, and Pratt Institute, and was structural designer for Ammann & Whitney.

Franklin E. Lowance, vice-president of research for the Crosley Division of the AVCO Corporation in Cincinnati, Ohio, has been named president of the Advanced Technology Corporation of Santa Barbara, Calif. Dr. Lowance brings to ADTEC, a new addition in the missile and space fields, more than 20 years of university and defense electronics experience.

Loren W. Olmstead, Colonel, Corps of Engineers, recently received the Society of American Military Engineers' Wheeler Medal in recognition—while district engineer at Buffalo, N. Y.—of his outstanding work on the St. Lawrence Seaway, which "enhanced the prestige of military engineering and contributed significantly to the nation's water resource development and transportation program." Colonel Olmstead is currently deputy assistant chief of engineers for civil works at Washington, D. C.

Leonard J. Isberg has been appointed to the electromechanical unit in the Materials and Processes Laboratory of General Electric's large steam turbine-generator department in Schenectady, N. Y. Mr. Isberg has been assigned to stress analysis, heat transfer and vibration.

George F. Ferris, for the past seven years president of Raymond International Inc., has been elected chairman of its board of directors, succeeding **Maxwell M. Upson,** who is retiring after 14 years in the post. Mr. Upson will remain on the board, however, as honorary chairman. At the same time, **Henry C. Boschen,** a vice-president and director since 1946 will move into the presidency.

William W. Wheeler and **Kenneth R. Wright** are moving their consulting hydrological engineering offices to larger quarters at 2133 South Bellaire Street, Denver, Colo. Prior to establishing the firm of Wheeler & Wright a year ago, both men had individual engineering practices in the field of hydrology.

Syracuse University Chancellor, William P. Tolley (right) presents the George Arents Pioneer Medal, the highest alumni honor, to J. Burch McMorran, class of 1922, for "excellence in civil engineering." Mr. McMorran, superintendent of public works of New York State, has been with the Department of Public Works since 1922, with time out to serve as chief engineer of the New York State Thruway Authority and as chief engineer of the Power Authority of New York State.

Guenther G. Rahm, whose experience as construction engineer includes supervision of various important private, public and Naval projects, has been named chief engineer of the Public Works Section of the Colorado State Planning Division, Denver. Mr. Rahm has been associated with the Public Work Section as construction and maintenance engineer since 1958.

Nicholas V. Feodoroff, associate professor of civil engineering at Manhattan College, New York City, has been invited by the Technological University Division of Applied Hydraulics to go to Delft, Holland, to deliver a series of lectures at the University this summer on the hydraulics of broad-crested weirs.

Scott H. Lathrop has been honored with the Engineer of the Year Award by the Engineering Council of Sacramento (Calif.) for the "gift of time and talent in the enrichment of his community as president of the Sacramento Council of Churches" during 1959. With the California Division of Highways since 1931, Mr. Lathrop is currently principal engineer and director of personnel and public information.

Donald L. Fentress, formerly with the Army Corps of Engineers, has opened a consulting civil engineering office in Berkeley, Calif. A recent assignment was as resident engineer in Samson, Turkey.

Frank A. Marston, President of ASCE and a senior partner in the Boston engineering firm of Metcalf & Eddy, received the honorary degree of Doctor of Engineering from Worcester Polytechnic Institute at its 92nd commencement exercises on June 10. Mr. Marston, a 1907 alumnus of the Institute, was one of four awarded honorary degrees.

John W. Green, after 30 years of service with the California Division of Highways, retired recently as supervising bridge engineer. His first job with the Division involved preliminary studies on the San Francisco-Oakland Bay Bridge. Later, he directed the design, preparation of plans, and specifications for the substructure and approaches. Following completion of the bridge, Mr. Green was in charge of all Bridge Department work in the southern part of the state until several years ago when he was made a representative of headquarters office of the Bridge Department working on studies and reports requested by the Legislature in connection with proposed bridge projects.

W. D. Broyles announces that under his direction Broyles & Associates will continue to provide the engineering services formerly handled by Broyles, Bynum & Doyle, Inc. The firm is located at 306 West Pearce, Baytown, Tex.

(Continued on page 28)

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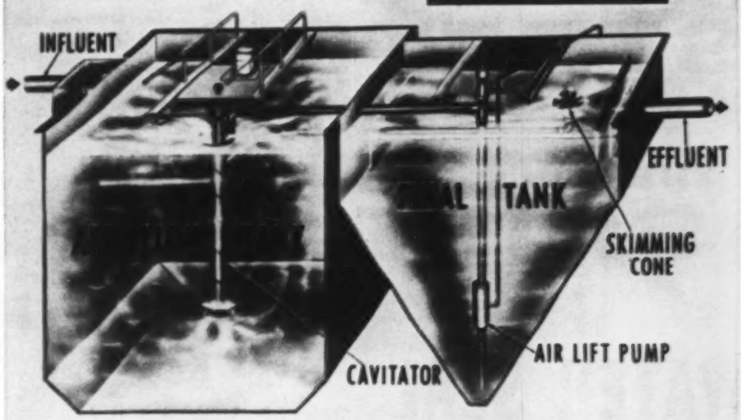

"PC" CAVITATOR®

Furnished as a complete plant for minimum on-site construction and labor

Make a simple excavation . . . pour a concrete slab. That's all the on-site construction this treatment plant requires. And, because the PC Cavitator is manufactured in standard sizes that meet the specifications of consulting engineers, the sewage treatment dollar goes farther. Fast delivery and quick startup keep construction schedules flexible, too.

These Yeomans prefabricated plants are built around the Cavitator which treats sewage by *aerobic digestion.* Standard systems are supplied in capacities from 2000 to 7500 gallons per day.

The Cavitator achieves a much higher oxygen transfer efficiency than other types of systems. Furthermore, it requires no blowers or compressors . . . no installation and maintenance of diffusion tubes or plates. There is nothing to clog. The simple mechanism requires only minimum attention.

When you buy a PC Cavitator plant, Yeomans can furnish a factory-trained engineer to supervise installation and train operators—taking up where the consulting engineer leaves off. The investment is further safeguarded because each PC Cavitator plant incorporates Yeomans' 60 years of experience in handling sewage. Investigate its advantages today!

ASK YOUR ENGINEER
ABOUT THE
"PC" CAVITATOR
AND WRITE FOR
BULLETIN NO. 101

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News of Members

(Continued from page 27)

E. C. Itschner, Lieutenant Colonel, Corps of Engineers, originally scheduled to retire from active service in September 1960 at the termination of his four-year term as chief of engineers, U.S. Army, will now serve for an additional two years. The extension of General Itschner's term had been recommended by the Secretary of Defense, the Secretary of the Army, and the Joint Chiefs of Staff.

John W. Hummel and **Robert B. George,** formerly of Hazelet & Erdal, Louisville, Ky., are opening offices of their own in Louisville at 811 Columbia Building. The firm will specialize in structural and civil engineering.

Robert B. Richards, chief engineer of De Leuw, Cather & Company, Chicago, Ill., has charge of the company's new offices at 744 Broad Street, Newark, N. J. Mr. Richards was chief engineer of the New York office under the firm name of De Leuw & Brill.

Robert T. Lawson, formerly a resident partner with Dames & Moore in San Francisco, has become a member of Harding Associates, San Rafael, Calif. A specialist in soils and foundation engineering, Mr. Lawson recently supervised soils investigations for the Fairmount Hotel tower and the proposed Federal Office Building in San Francisco, a proposed nuclear power plant at Bodega Bay, Calif., and a power plant utilizing steam from geysers at Geyserville, Calif.

William Orme Hiltabidle recently received a "Citation of Merit" from the National Military-Industrial Conference for his contributions "toward the advancement of military engineering and the national defense of the United States." Mr. Hiltabidle, a retired vice admiral in the U.S. Navy, is currently vice-president of the Chas. H. Tompkins Company, Washington, D. C.

Adrian Pauw will lecture on concrete technology next year at the Delft Technical University in Delft, the Netherlands, under a Fulbright grant. Dr. Pauw, who is professor of civil engineering at the University of Missouri will also engage in research with Prof. A. M. Haas of the Technical University, a world authority on thin-shell concrete construction.

Mitchell J. Alster is a recent addition to the staff of Thomas O. Miles, Jr. & Associates, Inc., of La Grange, Ill. Before joining the firm, Mr. Alster had a structural engineering practice in Chicago under the name of Mitchell J. Alster and Associates.

(Continued on page 112)

. . . . . Am-Soc Briefs

▶ ▶ Last-minute flash from Reno. . . . As this issue goes to press the Reno Convention is in full swing — look for complete coverage in the August issue. The Board of Direction, in session early in the week, nominated Prof. Glenn Holcomb, former ASCE officer and head of the civil engineering department at Oregon State College, for next year's President (page 41); selected four new Honorary Members; and endorsed the Prize Committee choices for the Society's coveted annual awards. Winners are listed in ASCE News.

▶ ▶ The four elevated to honorary membership — the highest award bestowed by the Society — are Guy Atkinson, retired construction contractor of San Francisco; Solomon C. Hollister, dean of the Cornell University College of Engineering; Frank Kerekes, dean of faculty at Michigan College of Mining and Technology; and Fred C. Scobey, consulting hydraulic engineer of Berkeley, Calif.

▶ ▶ Headquarters staff changes. . . . Don Reynolds has been appointed Assistant Secretary of the Society to replace E. L. Chandler, who retired recently. He will continue to administer ASCE technical activities. Don King will continue as Assistant to the Secretary in charge of coordinating the professional activities of the Society. In addition, the Board recommended that the Constitution be changed to permit having more than one Assistant Secretary. E. Stuart Kirkpatrick has been appointed Administrative Assistant to the Secretary. Otis Gouty, with the assistance of John Fisk, will direct the field services.

▶ ▶ Eyes still on the UEC. . . . Though the Board was jubilant on hearing that ASCE's share in financing the United Engineering Center has been reduced to less than $30,000, it directed that "intensive emphasis" be placed on the drive until it is successfully completed. It is the fine action of the Cleveland, Buffalo, and Wyoming Sections in completing their drives, plus great progress in the Los Angeles Section, that has brought the Society to within 4 percent of its goal. . . . From the construction standpoint, the Center has reached the cornerstone-laying stage (page 42).

▶ ▶ While the Reno Convention is still front stage, Massachusetts Section members are absorbed in the program for the Annual Convention, to be held in Boston, October 10-14. Technical program emphasis will be on research and urban renewal. . . . More about this Convention in subsequent issues, of course.

▶ ▶ Get your free copy of the 1960 ASCE Directory of Membership! Request for this invaluable publication must be made to Society Headquarters. The Directory is described in ASCE News, and the coupon for ordering is on page 96.

BIRD'S EYE VIEW OF RESPONSIBILITY

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The gross national product reached the $500 billion mark in the first quarter? This all-time record represents a rise of almost $17 billion over the last quarter of 1959. In releasing these figures at a recent meeting of Washington Trade Association Executives, Secretary of Commerce Frederick H. Mueller predicted that 1960 will be "the best year yet."

* * *

Bridge heights on the Atlantic Intracoastal Waterway are being lowered? A compromise brings the vertical clearance down to 65 ft. Waterway operators have been arguing for the present 80-ft clearance, and highway interests for reduction to 55 ft. The Corps of Engineers has fixed on 65 ft as best serving all interests concerned. The decision will affect all Waterways bridges between Norfolk, Va., and Port Everglades, Fla.

* * *

The Chile earthquakes have changed water levels in U.S. wells? Seismic waves traveling through the earth's crust after the recent catastrophe were recorded in water wells from Florida to Wisconsin and in Hawaii and Puerto Rico. In Hawaii, which was most affected, the fluctuation was sometimes over a foot. According to the U.S. Geological Survey, this is a common occurrence after large quakes.

* * *

Highways will get a year's wear in a week on a new kind of test track? The track is a 26-ft-dia facility under construction at the University of Illinois. First tests, to start in September, will try out new low-cost materials for secondary roads and city streets. Two truck wheels at the ends of a beam pivoted in the middle of the test track will spin along the 50 ft of highway at speeds of 3 to 25 mph with loads varying from 1,700 to 3,000 lb per wheel. Industrial sources have pledged $13,200 a year for five years to support the project. George W. Hollon, A.M. ASCE, of the Civil Engineering Department, will be in charge.

* * *

An entirely new approach to public health problems is needed? A major new division in the U.S. Public Health Service is being planned to deal with the contamination of air, water, and food supply that has accompanied 20th century progress, according to Surgeon General Leroy Burney. To cite some problems, the U.S. is holding 65,000,000 gal of deadly radioactive waste, and by 1980 will have accumulated another 65,000,000 gal.; in 1900 some 2,000,000 people got their drinking water from streams, into which 24,000,000 people dumped their sewage, whereas today 100,000,000 depend on the same streams for water and 120,000,000 people use them for sewage disposal.

* * *

The U.S. has a record number of construction firms? The Department of Commerce reports that, on January 1, there were 473,000 construction firms in operation—2 percent more than in 1959 and an all-time high. This is seen as one reason why contractors' bid prices are currently holding the line.

* * *

The U.S.S.R. has four new hydroelectric stations with capacity greater than Grand Coulee? They are Kuibishev and Stalingrad, now producing power on the Volga; and Bratsk on the Angara River, and Kraznoyarsk on the Yenisei (both under construction in Siberia). The Bratsk and Krasnoyarsk stations, each designed to 3,200,000-kw capacity, are the initial units in what is planned as an enormous electrometallurgical and electrochemical complex. Grand Coulee, which has long been the largest single hydropower producer anywhere, has an output of 1,974,000 kw. Source of these figures is a bulletin on "Water Resources Development Programs of the United States, Soviet Russia, and China," printed for the Senate Committee on Interior and Insular Affairs.

* * *

Engineers' starting salaries are up again? This is the word from St. Louis University, where top salary offers this June went to technical and scientific graduates—the average of $516 a month represented a slight increase over last year's $512. In business, starting salaries were $425 (up 3 percent from last year), and liberal arts graduates were averaging $383, a marked drop from the 1959 average of $407.

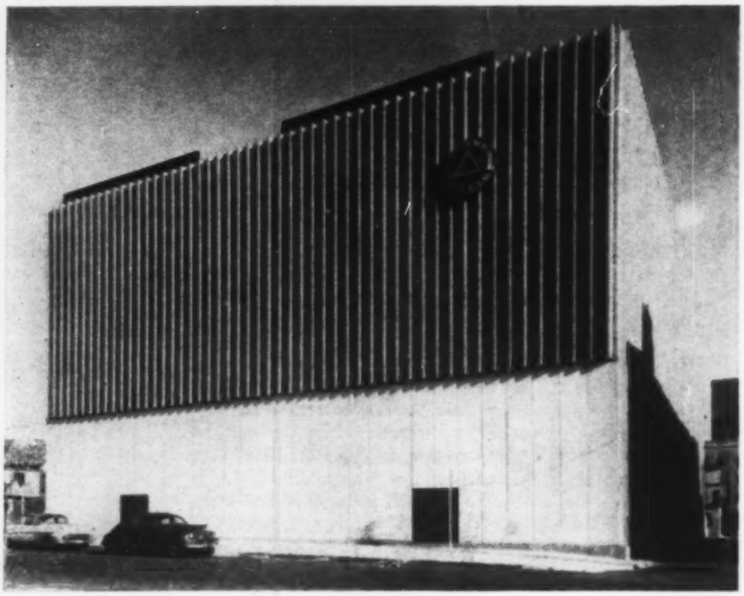
* * *

The Bureau of Reclamation is making available its dam-building experience? Specialized and highly technical data amassed in half a century of dam building work are presented in a 611-page volume entitled "Design of Small Dams." Copies are on sale at the Bureau's Denver or Washington headquarters for $6.50.

* * *

The Corps of Engineers is 185 years old? At its birthday, on June 16, many cities and towns flew the Corps flag in a salute to commemorate its achievements in the development of the nation's water resources. The Engineers' flag—red with a gold-turreted castle—has been in use since 1839

STRESSING DESIGN



Prestressed Concrete Double Tees Standing on End Provide Imaginative New Wall Treatment

● Double tee beams of prestressed concrete, best known for their value in roof and floor systems, are now finding an attractive new use. A recently completed switching station of the Public Service Electric & Gas Company of Newark, N. J. has two walls made of side-by-side 10-ton vertical double tees running the full height of the building—nearly 61 feet—and creating an interesting pattern.

A third wall, featured in the photograph above, is topped by tees 39½ feet tall. The bottom section of this wall employs removable flat concrete slabs, to facilitate the replacement of major equipment.

The architect found that using prestressed double tees in this manner had economic as well as design advantages—including off-site fabrication and stockpiling, fast erection with minimum personnel, no scaffolding, and lower heating costs due to better insulation.

To produce the 5,000-psi concrete specified for this job, the prefabricator chose dependable 'Incor'® 24-hour cement.

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Newark, N. J.

Consulting Architect
OFFICE OF ALFRED EASTON POOR
New York City

General Contractor
EDWARD M. WALDRON, INC.
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'Incor' Prestressed Members
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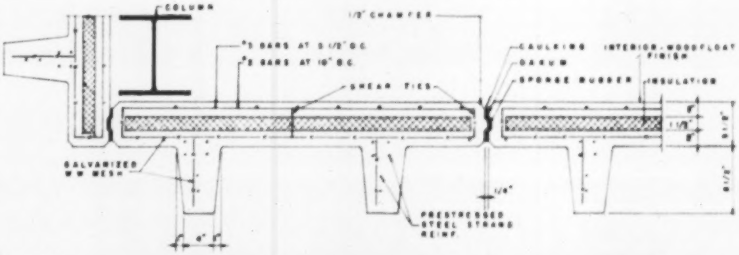
Glass fibre insulation was sandwiched between layers of concrete in the crossbar of the double tee unit to provide an excellent thermal barrier.

HORIZONTAL SECTION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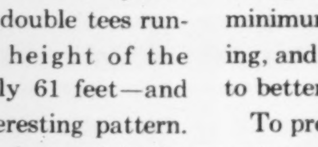
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CIVIL ENGINEERING

Prepared from President Marston's Annual Address at the ASCE Reno Convention

PROGRESS in ASCE

FRANK A. MARSTON, President ASCE

Partner, Metcalf & Eddy, Boston, Mass.

■ PROGRESS is a familiar word to Americans. The slogan, "Progress is our most important product," expresses this aim, characteristic of American life in business, in education, in science, in engineering in general, and in the American Society of Civil Engineers in particular. Progress in ASCE has been noteworthy in many ways.

The total enrollment of ASCE has grown as follows:

1852	(Nov.)	14	Beginning
1902	(May)	2,603	50th Anniversary
1942	(Sept.)	18,000	
1952	(Sept.)	34,979	Centennial
1956	(Sept.)	38,786	
1960	(May)	45,184	

In recent years around 40 percent of the membership has consisted of younger members. now designated Associates. Such growth is highly encouraging, but it incurs an obligation to make the Society of even greater value to the individual member.

Technical activities

A multitude of activities are conducted through the organization of the Society to develop engineering techniques. Such activities are carried on through the fourteen Technical Divisions under the over-all leadership of the Committee on Division Activities, a committee of the Board of Direction. At present, under the guidance of these Technical Divisions, there are some 268 committees and about 1,300 members working on many important subjects of technical interest to civil engineers.

Each member of the Society has the privilege of registering to receive the publications of two of the Technical Divisions. Such registrations have increased rapidly in number from 23,000 in 1955 to the present total of over 60,000.

ASCE has recently accepted a greater responsibility for research, particularly basic research in the broad field of civil engineering. The Society is now furnishing the administrative and fiscal services for two research councils, the Reinforced Concrete Research Council, and the Research Council on Pipeline Crossings of Railroads and Highways.

Research awards made

All fourteen Technical Divisions now have research committees studying ways by which research can improve engineering techniques, operating under the general administration of the Society's Committee on Research. It has become the practice for ASCE to make five research awards each year at a convention of the Society. There is also a Research Fellowship, established in 1958 by the Board of Direction, "for the purpose of aiding in the creation of new knowledge for the benefit and advancement of the science and profession of civil engineering." A grant of $5,000 is made annually; the first was awarded in 1959.

In September 1959, the Society's Committee on Research conducted a successful Second Conference on Research in Civil Engineering at Northwestern University. The report of the Committee to the Board of Direction concluded in part as follows:

". . . the participants in the Second Research Conference share the view that present research activities of the Society are inadequate, that this lack is detrimental to the professional standing of the civil engineer. . . ."

Basic research in civil engineering is an important phase of ASCE progress. We have made progress already. There is much more that can be accomplished through planned effort and dedicated service.

In the field of publications, the Society has maintained its world-wide reputation and widespread coverage over the fourteen specialized phases of civil engineering defined by its Technical Divisions. In the field of professional practice the Society supplements articles in CIVIL ENGINEERING with its Journal of Professional Practice.

The technical journals have been steadily improved in appearance and quality in response to a well-defined demand by the membership.

Improved publications

Authorization has been given by the Board of Direction for the compilation and printing of annual indexes to *Proceedings*, *Transactions* and CIVIL ENGINEERING; also for the printing of a complete cumulative index volume, containing three separate indexes, one for each of these three publications. Such index volumes will be of inestimable value to members of the Society and to the profession in general.

It is essential that the century-long series of annual *Transactions* be continued. The volume for 1959 contained 48 papers of varied interest and of high value to civil engineers. Competition for space in this volume is always acute.

Advances have been made in inter-Society communications, the lack of which has been a source of criticism in the past. The dissemination of personal news and Society news has been an ever-present problem. Such news is presented as generously as possible in the monthly magazine CIVIL ENGINEERING, which goes to every member. However, there is need for specialized news items in the Technical Divisions and these are being met by an increasing emphasis on the Division Newsletters. All the Divisions now send out newsletters to those registered in them.

This month more than 45,000 members, plus 5,000 libraries and construction subscribers, have received an issue of CIVIL ENGINEERING that is about 2½ times as large as Volume 1 Number 1, with a ten-fold increase in advertising.

Over the past thirty years CIVIL ENGINEERING has maintained its position as a leader in the field of engineering publications. Reader surveys indicate that our members spend more time reading it than any other engineering monthly. Twice in recent years it has been awarded plaques for editorial excellence.

Recently CIVIL ENGINEERING has put greater emphasis on professional activities within ASCE. More space and more attractive layout of "ASCE News" are being used to attract the attention of readers and to develop greater interest in the Society.

Prior to 1956, CIVIL ENGINEERING did not produce sufficient revenue to cover the cost of its operation. In that year, however, revenues exceeded costs, and since that time every year there has been a surplus which has been put to use for other Society activities.

The Society's Annual Report deserves special mention here. In content, appearance and handling, it has improved considerably in the past few years, and it will continue to be an effective instrument in reaching the members of the Society.

Value of public relations

The Department of Public Relations of ASCE, now in its third year of operation, has brought to public notice more of the work of the civil engineer. One important development has been the award for the "Outstanding Civil Engineering Achievement of the Year." The project selected through annual competition is given recognition at a public ceremony thereby bringing to the notice of the general public both ASCE and the accomplishments of the engineering profession.

The first award, that for the year 1959, was made on May 19, 1960, at Massena, N. Y., where four plaques were presented—two to agencies in Canada and two to agencies in the United States responsible for the St. Lawrence Power and Seaway Development. This award is most significant in that—in these times of dissension among nations—a project of such magnitude and complexity can be conceived, designed, managed and built by two nations working together in harmony, and except for certain necessary legislation, following only the time-honored method of a "gentleman's agreement."

Looking back on the colorful ceremony of presentation of the awards, held in the beautiful new Robert Moses Power House at Massena, attended by a distinguished audience of leading engineers, administrators and ladies, I cannot escape the conviction that, in years to come, this "Outstanding Achievement of the Year" award will add much prestige to the American Society of Civil Engineers.

UEC, a great project

ASCE is nearing the fulfillment of its quota of $800,000 in the building fund campaign for the United Engineering Center. The ground-breaking ceremony for the building was held in New York on October 1, 1959, and the cornerstone was laid on June 16, 1960. On that date steel erection had reached the 13th floor. Past President Friel, in his address of May 5, 1959, called this Center "a powerful symbol of unity in the engineering profession."

Any civil engineer who considers that his chosen vocation is that of a professional engineer, a member of the American Society of Civil Engineers, who has neglected thus far to have a part in this most important project of the engineering profession, will surely have regrets when he realizes that he is to benefit from the advantages that others have provided for him.

Today there appears to be a growing disregard for honesty and fair dealing in business relations, in TV shows, in some labor union managements in competition for engineering projects and in other phases of everyday life. This is to be regretted greatly, and especially if it applies to a member of the engineering profession.

Professional obligations

Considerable study has been given by the ASCE Committee on Professional Practice to the Code of Ethics with a view toward revision or expansion of its principles, and toward the preparation of a single manual that will combine the interpretation, amplification and application of the Code, and include other matters related to the ethics of engineering practice.

The Society in January 1950, by Board action, adopted the Canons of Ethics which were formulated by the Engineers' Council for Professional Development, consisting of 28 Sections. The Foreword to these Canons begins with this statement.

"Honesty, justice and courtesy form a moral philosophy which, associated with mutual interest among men, constitutes the foundation of ethics."

To be a member of one of the learned professions—whether it be law, medicine, the ministry, or engineering—involves the solemn obligation to act honorably and with dignity, and to follow the prescribed rules of practice and codes of ethics. The more consistently these established principles are followed in engineering the greater will be the position of engineering as a profession in the world today. The more they are followed by members of the American Society of Civil Engineers, the stronger the Society will be and the greater will be its impact on national affairs.

New lower deck is being added to the George Washington Bridge, which connects New York and New Jersey.

Erection of the lower deck—George Washington Bridge

E. L. DURKEE, Engineer of Erection, Erection Dept., Fabricated Steel Construction, Bethlehem Steel Company, Bethlehem, Pa.

Erection of steel for construction of a lower deck on the George Washington Bridge across the Hudson River in New York City is now about completed. The structure has a center suspended span of 3,500 ft (exceeded only by that of the Golden Gate Bridge at San Francisco) and side spans of 610 and 650 ft. Although provision was made for such an addition at the time the structure was designed (it was opened in 1931) no detailed scheme or method for adding the new roadway was prepared.

Field work on the lower deck started in March 1959. At the May meeting of thet Metropolitan Section of ASCE, the writer gave a talk outlining the proposed method of construction, with slides to show special erection equipment and devices, and describing the proposed erection procedure. Work has now progressed to the point where it can be said that the planned equipment and procedures have proved adequate in every respect. Data from that talk are used extensively here.

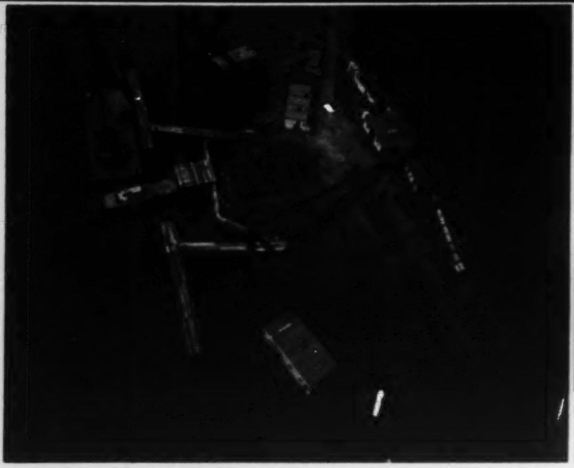
The deck of the present structure follows the more usual type of floor construction for suspension bridges. Floor beams 10 ft deep by 118 ft long, at 60-ft centers, support ten framed-in stringers 5 ft 8 in. deep spaced 12 to 14 ft apart. The floor beams are supported at each end by the double-hanger or suspender connection to the cables.

The new, lower-level deck is supported on a conventional type of construction, similar to that of the upper deck, except that the 7-ft-deep floor beams are spaced 30 ft on centers and the stringers are 24 WF 76 beams spaced 5 ft 7½ in. on centers and supported on top of these beams. Two 36-ft roadways are provided, the deck being a 4¼-in. steel I-beam grid, concrete filled, with a 2-in. wearing surface. A narrow escape walk with aluminum grating is provided on each side. The space between roadways is covered with aluminum mesh. A typical cross section through the revised structure is shown in Fig. 1.

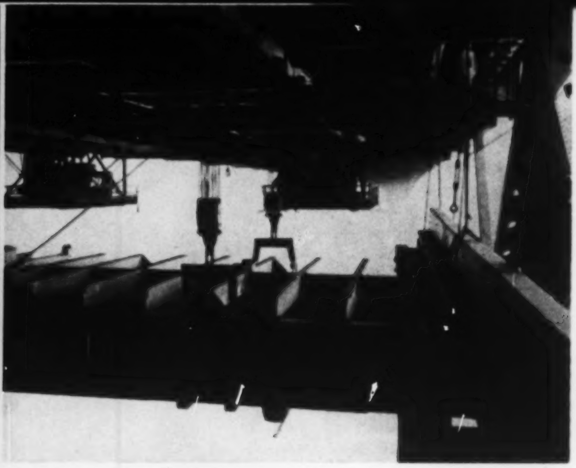
Before steel erection could commence, it was necessary to drill the connection holes for the new steel in gusset plates under the wind chord, the only part of the second deck erected with the original structure. Support for the lower deck is entirely through the connection of the new stiffening-truss members to these gussets. Permanent maintenance bridges for the new lower deck were adapted as a working platform for this drilling.

About 20,500 holes were drilled, each accurately located by metal templets. An additional 18,600 holes in these connections, originally subdrilled, were reamed out to full size, and another 9,000 holes were drilled for the tower alterations required to accommodate the new roadway, making a total of 48,100 holes drilled or reamed from mid-June through August 1959. The four maintenance bridges were then removed and altered for reuse.

The general procedure followed in erection was to place the steel from the anchorage out to the towers on each side of the bridge. Erection equipment was then moved through the towers and advanced from each of



Two stiff-leg derricks with 115-ft booms and 20-ft jibs operate in New Jersey assembly yard.



Hoist, in background, lifts steel through 15-part falls connected to the floor beams.

them nearly symmetrically toward the center of the bridge. The specifications required that erection of the new lower deck should not in any way interfere with the flow of traffic on the upper deck. There was no precedent for this type of erection and an entirely new concept was necessary both as to procedure and as to equipment. In fact, completely new erection equipment had to be devised and fabricated.

Studies showed that erection in pre-assembled units as large as possible would be most economical. A two-panel assembly complete with truss members, floor and bracing, weighs about 220 tons, which would put a load of 55 tons on each of four sets of lifting falls.

For the relatively short side spans, a different method of steel erection had to be used (Fig. 2) from that found best suited for the over-water main-span work. These side spans are over quite rugged land on both sides of the river. A little space was available along the shore at each tower. Here assembly equipment was set up to take units from railroad car-floats or barges and assemble it into the two-panel units. For the part to be erected under the New York side span, the steel was assembled on a wide-gage car that moved on rails to a position under the bridge. On the New Jersey side, two standard-gage tracks on 30-ft centers and four special trucks were used to assemble the units and move them into position. For the over-water sections, the units were assembled on barges for transport to a position under the span and lifted directly into place.

On the New York side, only a relatively small assembly area was provided to service only that side span. The installation consists of a light dock for mooring barges and a stiffleg derrick of 75-ton capacity set up on the rocky shore.

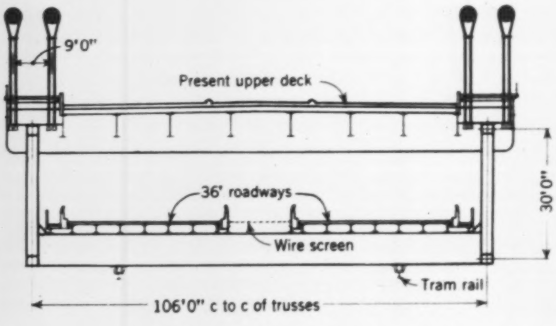


FIG. 1. An additional six lanes of traffic will be carried on new lower deck of the George Washington Bridge connecting New York City with New Jersey.

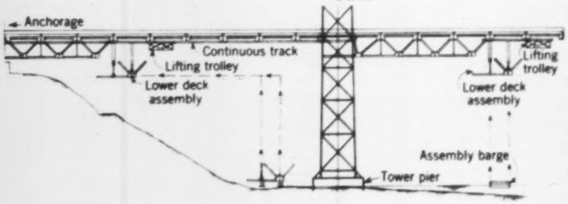


FIG. 2. Steel for the side spans was lifted vertically near the tower and carried toward the anchorage by the lifting trolley. For the main span, over water, the steel was lifted from a barge located under the point of placement.

On the New Jersey side, the installation was more elaborate. It consisted of two derricks of 115-ton capacity with 115-ft booms and 20-ft jibs, capable of handling loads up to 35 tons at a radius of 115 ft. The derricks were supported on steel-pile footings: a series of mooring piles were provided for tying up the barges used for the transfer of materials and equipment. In addition to space for the railroad car-float and barges for assembly of units, space was provided for material barges that could temporarily store parts and thus quickly release the car-float.

Erection of the 17,437 tons of new steel, including 3,300 tons of steel-grid floor, greatly increases the stress in both the cables and the towers and, if no adjustment were made, would cause each tower to lean about 13½ in. towards the river. Provision was made in the original design to compensate for this change in stress by supporting the saddle castings on rollers to permit movement between tower and cables. Each saddle rested on a roller nest made up of 41 steel rollers 8 in. in diameter and 8½ ft long. The saddles were fixed in position on top of the tower by steel struts 7 in. square and shims between the ends of the saddle and jacking brackets on each side of the tower. The rollers had been packed in grease, which was now cleaned out to insure that they would move easily.

It was decided to introduce a preliminary jacking movement of about 6 in. before erection of any of the new steel and to jack the remaining 7½ in. of movement after the steelwork was erected but before the concrete deck was poured. This procedure would keep tower movement within permissible limits during erection.

It was feared that over the 30-year period the bridge has been in use, the high bearing pressure on the rollers might have caused them to "set" or become slightly imbedded in the bearing slabs, thereby greatly increasing the theoretical jacking force required to move them. Two 800-ton jacks were provided between each cable saddle and the tower, providing a total horizontal thrust of 1,600 tons per saddle or per cable. Since there are a total of four cables, each 36 in. in diameter, the total jacking force provided was 6,400 tons on each tower. The general arrangement of the saddles and jacks is shown in Fig. 3.

Preliminary jacking was done in September 1959. The first movement between the tower and the saddle occurred under a load of only 160 tons per cable or 640 tons on the tower, producing a movement of $\frac{1}{2}$ in. Shims were removed from one end of the saddle and introduced at the other end to permit this movement. Additional jacking increased the load to 200 tons per cable and the movement increased to about 2 in. As jacking continued, the resistance increased, and for the final increment of the total movement of $6\frac{3}{16}$ in., the jacking load was 362 tons per cable, or 1,448 tons on the tower, which was only a little more than one quarter of the jacking capacity provided. It is interesting to note that, of this total movement of $6\frac{3}{16}$ in. between the cables and the tower, $5\frac{7}{16}$ in., or 88 percent, was in the form of a deflection of the 593-ft-high tower shoreward, and only $\frac{3}{4}$ in., or 12 percent, was in movement of the cable saddle. This $\frac{3}{4}$-in. horizontal movement of the cable saddles in space produced only a very small change in cable sag and roadway elevation.

Traveler operates under bridge

For hoisting and erecting the assembled sections, four special erection trolleys or travelers were built to run under the present roadway, each on two lines of track beams, borrowed from the steel for the new lower deck. The beams were supported from the bottom flange of the existing roadway stringers. The erection trolleys work in pairs, each supporting two sets of lifting falls having 15 parts of $\frac{3}{4}$-in. wire rope. Each trolley has a 200-hp, three-drum, gasoline-powered hoist with a line pull of 20,000 lb. Two drums are used to operate the two lifting lines simultaneously, resulting in a line pull of 9,500 lb per drum. The maximum height of hoist at the center of the span is 214 ft; it required about 20 minutes for a lift.

In order to get the assembled two-panel units into position under the side span, each unit was lifted first to near deck level at the tower by the lifting trolleys and then moved out by traveling on the lifting trolley.

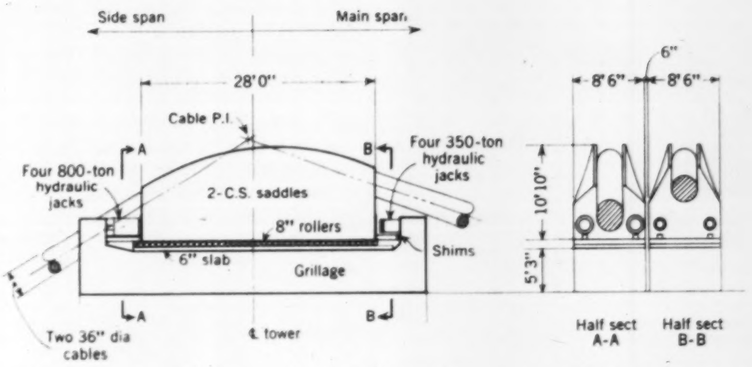


FIG. 3. Added load of the new lower deck would cause the 593-ft-high towers to deflect 13½ in. toward the river. This movement was compensated for by moving the cable saddles on the towers.

In each side span a continuous track of four lines of stringers was erected from the tower to each abutment. The erection trolleys moved the first steel out to the abutment over the track, working progressively back to the tower. A schematic plan of lower-deck erection is shown in Fig. 2. A detail of the trolley truck is shown in Fig. 4.

Erection of the trolleys and trolley tracks in the side spans took place in September and early October of 1959. Field work was tied up by a steel strike from mid-October to mid-December. The first complete deck assemblies were erected on each side of the river in mid-January 1960, and the side spans were completed in early March. Erection of the new floor in each tower and the moving of erection trolleys through the towers was a difficult operation. Erection of the steel in the main span started March 29 and was completed June 16.

Erection of steel in the main span was quite different from the same operation in the side spans, since the assembled units could now be erected on barges and floated into place directly beneath their final location in the structure. An anchor barge was provided with four anchors, two placed upstream and two downstream. A series of anchor locations was worked out such that several positions of the anchor barge could be provided from one setting of the anchors. The anchors were accurately located by targets on each shore, and opposite selected panel points in the bridge. The barges carrying assembled units could then be floated into position and tied up securely to the positioned anchor barge.

The erection trolleys operated in the main span in a manner similar to that in the side spans, except that a fixed length of the track beams was now made a part of the trolley. As the erection trolleys were moved from one position to the next, supporting hangers

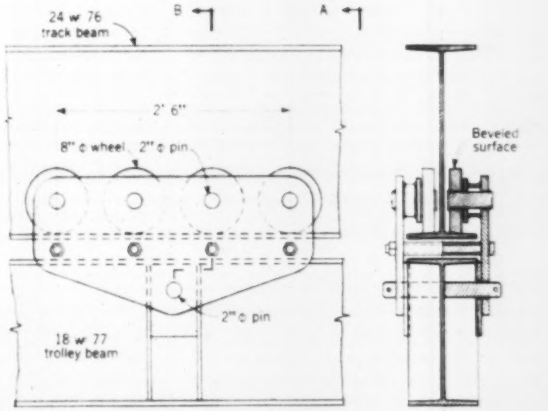
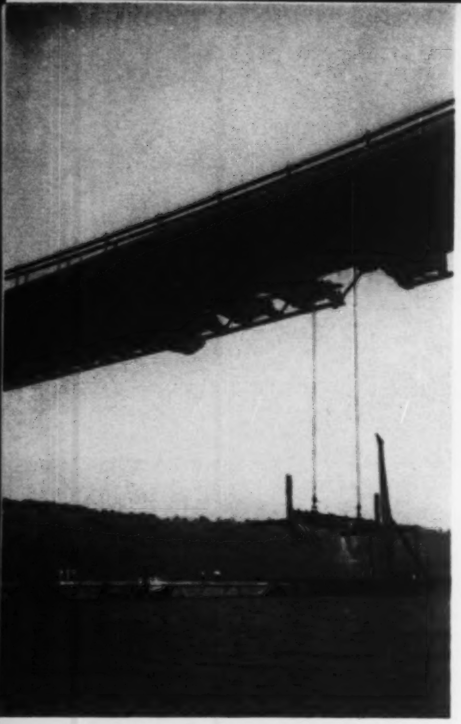


FIG. 4. Detail of trolley truck for carrying 220-ton sections of steel to position.



The last section of steel was placed June 16th to complete framing for the new lower deck of the bridge. Port of New York Authority photo.

from the existing stringers were removed from behind and erected ahead so that the track beams could be rolled through them. Extended platforms on the trolleys provided a working platform for this purpose, the hangers being dismantled and handled entirely by hand.

Assembly of the 220-ton units in the yard was scheduled so as to keep the erection crews on the two trolleys continuously busy—alternating between the two sides of the river. The most time-consuming operation for the erection gangs was the removal and re-erection of the trolley hangers and the moving of the trolleys ahead to the next working position. Actual movement of the trolleys was by means of the hoisting engine on each. The average distance between hangers is 10 to 12 ft, and there are two lines of track beams for each trolley, which carries two of the four lifting falls. On each side of the river there are two such erection trolleys, or travelers, required for erecting each assembly. See Fig. 4.

Simple leveling device

During the actual raising of the assembly, it is essential that the load be equally divided among the four sets of falls, and this in turn requires that the falls be operated at the same speed so as to keep the assembly level within a very small tolerance. Two mercury switches at each of four locations serve as leveling devices, operating one red and one yellow light in an open topped black-painted box. The switches are set so that the yellow light will go on if the assembly gets out of level as much as 18 in. in 106 ft. The red light comes on if the out-of-level becomes 3 ft in 106 ft. Usually as soon as the yellow light shows, the assembly can be leveled by regulating the speed of the hoists, but if the red light shows, hoisting is stopped until the assembly can be releveled.

Each unit as it is erected must be entered at eight points simultaneously—at four points on each truss, at the bottom chord, at the vertical and at the two diagonals. To facilitate entering, each joint was provided with a total clearance of ¼ in. between the gussets, and the members temporarily connected that way, without fillers. Later, during final fitting up for riveting and bolting, a ⅛-in. filler plate was inserted on each side of each connection.

As the various sections are erected, all bottom-chord joints stand open, lengthwise, because of the shape of the structure at the time, under the condition of partial loading. The new steel is detailed so that these joints will not close until all the steel has been erected. Since these joints cannot be connected or fitted up as erected, a special device was fabricated consisting of a pair of angles temporarily welded to the top cover plate at the projecting end of the chord. These angles were shaped so as to guide the chord in between the gussets as it was raised into place, so that no men were required at these points.

The bottom chords at the open joints all have milled end-bearing surfaces so that, as the joints start to close from the increased loading, the open holes will come into register and can be pinned and bolted at convenience. The closing bottom chord at the center of the span is provided with a ¾-in. clearance at each end to insure that it can be entered as erected, regardless of temperature or the exact shape of the stiffening truss at the time. Some local loading of the roadway, as by heavy trucks, or some jacking was expected to be necessary to finally connect this chord. Also, a special procedure for pouring the concrete roadway was worked out to prevent overstressing of any truss members. Actually the closure section went in without any difficulty.

At the other six points where the members entered between the gussets, men were stationed to guide the members in and to make the connection. The vertical connections with extended splice plates and angles caused the greatest difficulty. The angles were finally bolted back entirely, to facilitate entrance to the connection, and then raised into place later with a small set of chain falls. After an assembly was started on its way between the gusset plates, no more than 15 to 20 minutes were required until the first pins were being driven, and 15 minutes later enough pins and bolts were generally in place to permit the lifting equipment to be detached.

The anchor barge was provided with a small derrick and a four-drum hoist for locating and moving the anchors, and for operating the anchor lines to position the barge. The gang on this barge also made the four connections of the lifting falls to the floor beams using special welded hitches and pennants designed and fabricated especially for the purpose. Only a single pin had to be inserted to complete the hitch for each pennant after it had been passed under the floor beam.

Immediately after an assembly had cleared the blocking, the anchor barge was moved. Either it moved to a new location, ready for the next assembly that was to be picked up, or else it pulled itself up to the anchors and raised each anchor in turn from the river bottom. A small tug moved the barge for repositioning the anchors.

Steel in 60-ft units

Each assembled unit on the barge consisted of two floor beams spanning 30 ft and the framing between them, which could all be completely erected at the yard. This left an open 30-ft panel between each adjacent assembly in the structure as the sections were hoisted into place. The material for this open panel was stored on the assembly and in such a manner as to be readily accessible in the order required. Immediately after an assembly was hoisted into place, a section of floor grating was pulled across the open panel between the adjacent assemblies so as to provide ready access the full length of the erected structure.

The open panels of floor, in alternate spans, were filled in using a truck crane of 35-ton capacity running on 2-in. planks laid directly on the steel floor grid. The crane was equipped with a 40-ft boom which, because of the low overhead clearance, could be boomed up and down only a few feet. It was operated nearly flat and at a fixed radius (Fig. 5). Its capacity was 5 tons at a 40-ft radius, without outriggers. The heaviest load it had to pick up was 4 tons, one of the sidewalk assembly sections. Filling in of the open panels followed closely behind the raising of the assembled sections.

To keep successive movements of the anchor barge to a minimum and to concentrate the work of erecting and fitting up as much as possible, erection of the main-span assembly started on the New Jersey side with the raising of three 60-ft sections, a length of 180 ft. The anchor barge was then moved to the New York side, where the first six assemblies, working out from the tower, were erected, a distance of 360 ft. The anchor barge was then moved back to the New Jersey side, where six assemblies were erected. This procedure was continued, erecting six sections on one side and then the same number on the other side of the river, so that at no time was erection on one side more than three sections ahead of that on the other side. This procedure tended to keep the cable and roadway deflections well balanced.

Small gangs handle steel

In the yard it was found that two assembly gangs could keep up with, and slightly ahead of the erection, and could also assemble as fast as the railroad could load and ship the steel on barges. This factor controlled the speed of erection. One erection gang was employed full time on the structure, alternating between the two erection trolleys on the New York side and the two on the New Jersey side. A fourth gang spent half its time on the erection trolleys on the New Jersey side, and the remaining half in filling in the open panels on the New Jersey side with the truck crane. A fifth gang was employed in filling in the open panels on the New York side and in other miscellaneous work at the anchorages and in the towers, and in erecting the drainage system.

All connections of new members to the gusset plates of the existing top chord were made by riveting. The use of high-strength bolts was found impracticable there because of the many coats of paint that had been applied to the gussets over the years and the difficulty of completely removing them. To facilitate erection, four special retractable riveting scaffolds were designed and mounted on a frame with wheels running on plank on the steel floor grating. An extendable platform surrounded the vertical hangers and gave full access to both faces of the truss. The rivet forge and heater were located on the floor, and rivets were passed to the driving gang through a pneumatic rivet passer. Each riveting gang did its own final fitting up, including the insertion of ⅛-in. fillers on each side of the truss members, which had been narrowed ¼-in. to facilitate erection.

All connections of truss members at the bottom-chord joints are made with high-strength A-325 specification bolts. These bolts were used exclusively for assembling the truss and floor sections on the barge. Proper tension in the bolts was determined by the turn-of-the-nut method.

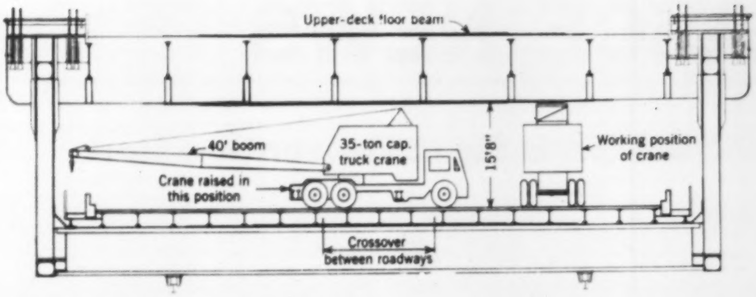

Upper-deck floor beam
40' boom
35-ton cap. truck crane
Crane raised in this position
15'8"
Working position of crane
Crossover between roadways

FIG. 5. A truck crane with boom almost horizontal was operated under the existing roadway to place fill-in steel in alternate panels.

The design and specifications required that the new lower-level floor beams be cambered so that they would be straight under full dead load of both steel and concrete. The hangers have a riveted top connection and a fully bolted connection at the lower end, and are relatively short and deep. To prevent excessive secondary stresses in these hangers, it was required that the lower floor beams be jacked so as to be approximately horizontal and the lower connection of the hanger to the floor beam bolted up in that condition. This jacking load was about 100 tons. As erected the lower floor-beam connection to the hanger consisted only of a pin of 7-in. diameter (Fig. 6). Because of the camber in the floor beam, the extreme holes in the hanger connection mismatched by about ⅛ in. Jacking rotated the end of the floor beam sufficiently to permit ready pinning and fitting up of this connection. A special jacking frame was designed, mounted on wheels, so that it could be rolled along the open floor grating from one floor beam to the next. The jacks were operated by hand pumps located on the frame.

Particular attention should be called to the many devices and other features incorporated in the erection scheme for the safety of the men. The special retractable platforms for both connecting and fitting up the assemblies to the existing structure, and for riveting and bolting, have been mentioned. The permanent maintenance bridges were used under the open panels of floor while these were being filled in.

The new lower deck was designed by the Port of New York Authority and is being built under its supervision. John M. Kyle, F.ASCE, is chief engineer: Irvine P. Gould, F. ASCE, directed the design; and H. A. Druding, M.ASCE, is resident engineer.

Contract for the fabrication and erection of the steel superstructure was let to the Bethlehem Steel Company. All steel was fabricated at its Pottstown, Pa., works. Field erection was in charge of the New York Erection District, with G. P. Adair, F. ASCE, Manager of Erection; James A. Sterner, Project Manager; and H. A. Hauck, A. M. ASCE, and J. J. Hayden, Field Engineers. C. E. Adams was General Superintendent with H. L. Facey, superinendent on the New York side and C. E. Huggans on the New Jersey side. The erection scheme was developed under the direction of J. H. Wagner, General Manager of Erection, and E. L. Durkee, F. ASCE, Engineer of Erection in the Bethlehem office.

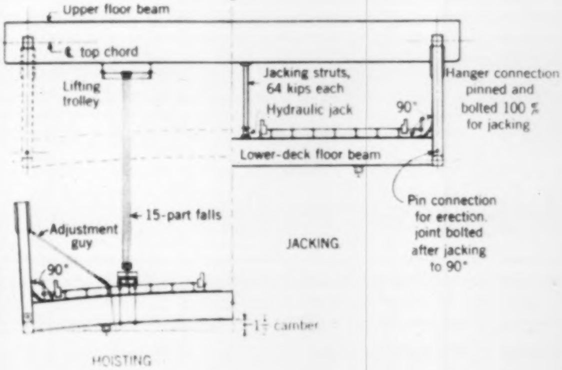

℄
Upper floor beam
℄ top chord
Lifting trolley
Jacking struts, 64 kips each
Hydraulic jack
90°
Hanger connection pinned and bolted 100 % for jacking
Lower-deck floor beam
Pin connection for erection. joint bolted after jacking to 90°
15-part falls
Adjustment guy
90°
JACKING
1½ camber
HOISTING

FIG. 6. Arrangement for lifting a unit of the deck and for jacking it into approximate full dead-load position.

ASCE NEWS

Boston is Next Convention Host

Boston will be the setting for this years's Annual Convention, to be held at the Statler Hotel, October 10-14. For some time the Convention Committee has been hard at work on what it hopes and expects will be a memorable program. Research and urban renewal will be stressed in both the technical sessions and the luncheon talks. Boston today is the center of a great deal of interesting urban renewal work, which will be on view to Convention visitors.

The luncheon programs are featuring such nationally prominent speakers as Dr. James R. Killian, chairman of the Massachusetts Institute of Technology Corporation and former Special Assistant to the President for Science and Technology; Gen. Alden K. Sibley, division engineer for the Army Corps of Engineers; and Dr. G. Brooks Earnest, president of Fenn College, Cleveland, and former ASCE officer.

General Sibley will also give a talk on the "Watertown Arsenal Reactor" at a joint meeting of the Construction and Power Divisions. "Operation Plowshare" and the "Yankee Atomic Power Plant" are other topics scheduled for this timely cooperative session. The City Planning and Highway Divisions are teaming up for an interesting panel discussion on "The Impact of Modern Rapid Transit Facilities," which will range from a new Boston transit line to the proposed New Orleans monorail. Other sessions will explore the economics of various types of urban transit. Various interesting local projects, such as the Boston Tunnel, will also be discussed.

Field Trips Planned

A number of special trips are being arranged to supplement the technical program. These include a tour of the Soil Mechanics Laboratories at Harvard and M.I.T., and the Army Corps of Engineers Soils Laboratory. The Corps is also arranging boat trips around the harbor. Highway engineers will want to see the Boston Central Artery, one mile of which is said to have cost about $50,000,000. Nearby is Route 128, known as Boston's golden industrial semicircle.

All kinds of interesting trips and diversions are also being planned for the ladies. Long known as "The Athens of America," Boston abounds with literary and historical associations. It is one of our few old cities that retains its colonial charm. On the agenda for the ladies are such landmarks as the Old North Church and Paul Revere's home, the Old State House, Bunker Hill, and the scene of the Boston Massacres. Concord, Lexington, and Plymouth Rock are within an hour's drive.

Some of the country's leading educational institutions are also located in the Greater Boston and New England area. The interest of these colleges in the Convention may be judged from the fact that, of fourteen Student Chapters queried, ten are already planning to have exhibits. These exhibits, of course, will be in addition to the usual commercial displays that have become an Annual Convention feature in recent years.

Program to Be Published

The Boston Committee is making every effort to provide the unusual in the program as well as the usual fine technical sessions. No one, it says, will be disappointed. The entire Convention program willl be published in an early issue.

William H. Mitchell is general chairman of the Convention, and Mrs. Arthur T. Ippen is chairman of the Ladies' Committee. Bruce Campbell is handling Convention publicity.

Gathered around a familiar Boston symbol to make plans for the Annual Convention are these Committee members: Prof. Charles H. Norris, president of the Massachusetts Section; Mrs. Norris, member of the Ladies' Entertainment Committee; Mrs. Arthur T. Ippen, chairman of the Ladies' Entertainment Committee; and General Chairman William H. Mitchell.

New Directory Is Available to Members

The 1960 Directory will be out in July and available to members on request. The Directory lists the entire membership of the Society, giving the membership grade, position, and mailing address of each. In addition, there is a complete listing of the Honorary Members, past and present, and the Life Members. A useful geographical listing of the members is also included.

It goes without saying that the information contained in the Directory is of value to every member, and every member can obtain this valuable information. To receive your free copy of the Directory simply fill out the coupon on page 96. Prompt delivery depends on prompt return of the coupon.

The Society publishes the membership Directory every other year. The next edition will be issued in 1962.

Glenn Holcomb Nominated for President

Glenn W. Holcomb, a well-known educator and chairman of the civil engineering department at Oregon State College, Corvallis, has been selected by the Board of Direction as the official nominee for 1961 President of the Society. Election will be by letter ballot during the summer, with installation during the Society's Annual Convention—in Boston, Mass., this year—October 10-14. Professor Holcomb has represented Zone IV on the Board—as Director of ASCE from 1953 to 1955 and Vice President in 1956 and 1957.

A civil engineering graduate of the University of Michigan in 1919, he received his M.S. in education from Oregon State College in 1931. In 1917 and 1918 he was in the Engineers' Reserve Corps of the Army, assigned to duty at the University of Michigan, part of the period as instructor in surveying and mapping. He has been on the staff at Oregon State College since 1920, advancing through the various positions from instructor in civil engineering to chairman of the department. Professor Holcomb's work at Oregon State has included teaching extension courses for professional engineers throughout the state. He was director of Engineering, Science, Management, War Training (ESMWT) for Oregon during World War II. He has been active in arousing the interest of engineers and contractors in the value of education and research to their work.

He is author of various engineering manuals and of engineering personnel and aptitude studies. He is currently a member of the Board of Engineering Examiners for Oregon, the American Society for Engineering Education, the American Concrete Institute, Professional Engineers of Oregon, and American Association of University Professors. He has also been active in many municipal and civil groups, including the Corvallis City Council.

GLENN W. HOLCOMB
Nominee for President

ASCE Prizes and Awards are Announced by Board

On recommendation of the Committee on Society Prizes, the Board at its Reno meeting approved the following awards for papers published in Volume 124 (1959) of Transactions and in Civil Engineering. The prizes will be presented during the Society's Annual Convention, to be held in Boston, Mass., this October. Brief biographies and photos of the winners are scheduled for the October issue.

Norman Medal

Carl E. Kindsvater and Rolland W. Carter, Fellows ASCE, for Paper, "Discharge Characteristics of Rectangular Thin-Plate Weirs."

J. James R. Croes Medal

H. Bolton Seed, M. ASCE, and Clarence K. Chan, A.M. ASCE, for Paper, "Thixotropic Characteristics of Compacted Clays."

Thomas Fitch Rowland Prize

Jack W. Hilf, F. ASCE, for Paper, "Compacting Earth Dams with Heavy Tamping Rollers."

James Laurie Prize

Ernest F. Masur, M. ASCE, for Paper, "Strength of Very Slender Beams."

Arthur M. Wellington Prize

John M. Biggs, M. ASCE, Herbert S. Suer, A.M. ASCE, and Jacobus M. Louw, for Paper, "The Vibration of Simple Span Highway Bridges."

Collingwood Prize

Ralph L. Barnett, A.M. ASCE for Paper, "Prestressed Truss-Beams."

On recommendation of the Technical Divisions, the Board approved the following awards:

Construction Engineering Prize

Joseph Peraino, F. ASCE, "Glen Canyon Dam," Civil Engineering, June 1959.

Rudolph Hering Medal

Charles G. Gunnerson, F. ASCE, for Paper, "Sewage Disposal in Santa Monica Bay."

Leon S. Moisseiff Award

Frank Baron, F. ASCE, and Harold S. Davis, M. ASCE, for Paper, "Pressure Lines and Inelastic Buckling of Columns."

Rickey Medal

J. Barry Cooke, F. ASCE, for Paper, "Haas Hydroelectric Power Project," and for "technical contributions and work toward progress in the technology of rockfill dams."

J. C. Stevens Award

Hans A. Einstein, F. ASCE, for his part in the discussion of the Paper, "Mechanics of Streams with Movable Beds of Fine Sand."

Theodore von Kármán Award

William Prager, F. ASCE, in recognition of distinguished achievement in Engineering Mechanics.

Thomas A. Middlebrooks Award

F. E. Richart, Jr., for Paper, "Review of the Theories for Sand Drains."

On recommendation of the Ernest E. Howard Award Committee, the Board also approved the following award:

Ernest E. Howard Award

Othmar H. Ammann, Hon. M. ASCE, "for design and construction of outstanding bridges of record dimensions, and large engineering works, including the George Washington Bridge, the Lincoln Tunnel under the Hudson River, and the Narrows Bridge now under construction at the entrance to New York Harbor."

Cornerstone Laid for UEC

Another milestone has been passed in the construction of the United Engineering Center. New York's Mayor Robert F. Wagner and former President Herbert Hoover, Hon. M. ASCE, headed cornerstone-laying ceremonies on June 16—just eight months after ground was broken for the UEC. Andrew Fletcher, president of United Engineering Trustees, Inc., owner of the Center, presided.

In the leading address, Mayor Wagner remarked that, "without engineers to regulate the rapid pace of modern times, we would have chaos."

"Our tribute," he said, "is not to a building because it will enhance the skyline of our city but because it will accommodate a class of professionally trained men and women who are dedicated with a common, unselfish interest—the benefit of their fellowman. To them, in large measure, we owe our day-to-day safety and the many comforts and conveniences that, as New Yorkers, we are likely to take for granted.

"In dedicating this cornerstone today we can contemplate the power, the integrity, and the precision which dictate the determination of professionally trained engineers and we can afford to feel confident that our best interests are their primary concern."

The mayor went on to say that the city is "grateful, too, for the fact that when the United Engineering Trustees agreed that their 50-year-old quarters could not be enlarged, they nevertheless elected to remain in New York and build anew. Our city is proud and fortunate to be known as the country's center of engineering activities. . . ."

"The stature and prestige of professional engineering must be preserved and advanced. . . . No longer is the engineer regarded as a man of war, but rather he has become one of us in the older professions and among us a force for the good of his community and our society as a whole."

In conclusion the mayor said, "I feel privileged to take part in this ceremony which is in the nature of launching an imposing, impressive and inspiring program which will endure to the equal benefit of engineering as a profession and to New York City as a center of training and experience, of education and employment.

"It is my hope that engineering will continue to preserve New York City as the marvel of the New World and that in cementing this symbolic stone we will have strengthened not only the foundation of a highly significant professional building but our healthy and dynamic society in which we have implicit confidence to surmount trouble and survive threat, not only during our time but beyond the distant future."

Mr. Hoover, who had been asked to contribute a forecast of what the world may be like when the cornerstone is opened a hundred years from now, noted that "one can only appraise the forces in motion today and speculate on their effect on the next century."

On the basis of progress in the past century, Mr. Hoover feels that "the nations possessed of independence and personal freedom" will be instrumental in bringing "more and more discoveries into the fundamental forces of the universe," and that engineers will then apply these discoveries to releasing mankind from less important tasks and bringing him more comforts.

Said the former President, "Even the problem of adequate food supply to a world faced with increasing numbers may yield to scientific discovery and invention. A century ago 80 percent of our population was employed on farms . . . , while today, thanks to advances in science and engineering, less than 20 percent of our population is required for this duty. . . .

"During the past century our profession of engineering has advanced from the status of a trade to a great profession ranking with all the other great professions." Mr. Hoover went on to say that engineering training in itself makes an important contribution to the world, because "the very nature of training for our profession demands intellectual integrity and minds to whom truth has become an instinct."

The cornerstone, which may be opened sometime in the twenty-first century, was cemented in place by the mayor, Mr. Hoover, and Mr. Fletcher. Behind it in a sealed metal container are documents and publications of each of the societies participating in the building of the center. The items chosen to represent ASCE were the Centennial Transactions volume, the current Membership Directory and the 1960 Annual Report.

Wielding the trowel that set the cornerstone for the UEC is former President Herbert Hoover, Hon. M. ASCE. Mr. Hoover is flanked by New York's Mayor Robert Wagner (right) and U.E.T. President Andrew Fletcher, who also took part in the ceremonies.

Steel Rising Rapidly

Those who witnessed the cornerstone laying were impressed by the speed with which the steel is going up. Erection had reached the thirteenth floor; topping out is scheduled for sometime in July. Structural details and interesting construction features are described in two articles in this issue.

Contributions Still Needed

With the articles on the Center, a form is printed (page 65) for the convenience of members who still want to have a part in the vital UEC project and for those who can add to their original contribution. The ASCE Headquarters staff will take care of the formalities and credit your contribution to your Local Section. Just clip the coupon—it's arranged so you do not sacrifice part of an article.

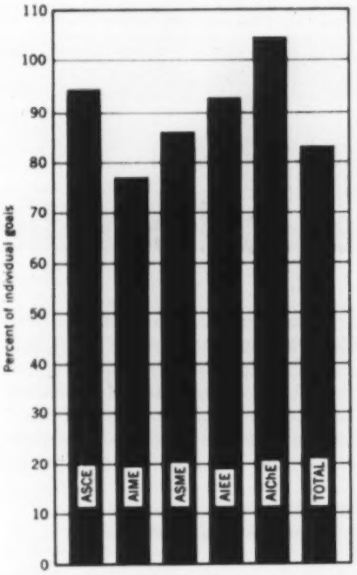
ASCE has now raised well over 96 percent of its quota. Since the accompanying bar graph was made the action of the Cleveland, Buffalo, and Wyoming Sections in completing their drives, plus progress in the Los Angeles Section, has brought the percentage up. Less than $30,000 will fill the ASCE quota. Your boost is needed to complete the drive.

As Executive Secretary Wisely put it in a recent letter to fund-raising personnel, "Now is the time for all Sections to put on the real pressure, so that we can bring this operation to a successful conclusion. There are other productive Society projects and activities that await our attention."

UEC HONOR ROLL

There are currently 40 Sections on the UEC Roll. Newcomers to the Honor Roll are Cleveland, Buffalo, and Wyoming. Civil Engineering takes pleasure in listing here the distinguished 40 who have met their quotas. They are listed in the order of meeting their goals.

Kentucky (122)
Lehigh Valley (138)
Nashville (102)
Cincinnati (141)
Columbia (135)
Philadelphia (152)
Hawaii (129)
Rochester (123)
Ithaca (142)
Southern Idaho (200)
Indiana (138)
Delaware (109)
Kansas City (116)
Central Pennsylvania (111)
Arizona (110)
West Virginia (140)
Central Ohio (107)
Tri-City (116)
Puerto Rico (117)
Wisconsin (106)
Georgia (110)
Maryland (109)
Tennessee Valley (107)
Metropolitan (117)
Connecticut (107)
Maine (103)
Rhode Island (101)
Alaska (107)
Central Illinois (108)
Syracuse (109)
Illinois (103)
Nebraska (106)
Iowa (105)
Duluth (100)
Virginia (101)
San Francisco (101)
Spokane (101)
Cleveland (100)
Buffalo (100)
Wyoming (100)



ASCE member-giving is over 96 percent completed. Only AIChE, which met its quota months ago, now surpasses ASCE.

Total Amounts Necessary to Meet Local Section Quotas

Section	Remaining Quota	Section	Remaining Quota
Tacoma	$ 224	Louisiana	$ 1,770
Montana	235	Brazil	1,795
Panama	295	New Mexico	1,830
New Hampshire	697	North Carolina	1,844
Mexico	675	Republic of Colombia	1,970
South Dakota	841	South Carolina	2,172
Texas	858	Venezuelan	2,183
Intermountain	859	Sacramento	2,495
Mid-Missouri	864	San Diego	2,742
Massachusetts	916	Pittsburgh	2,983
Akron	1,017	Alabama	3,993
Dayton	1,024	Northwestern	3,999
Toledo	1,037	Mid-South	4,209
Oklahoma	1,076	Oregon	4,738
Seattle	1,346	Florida	7,294
Mohawk-Hudson	1,587	Colorado	8,292
Kansas	1,619	Michigan	9,310
St. Louis	1,683	Los Angeles	10,551
Miami	1,730	National Capital	10,720

Transactions of Sixth Congress on Large Dams

The Transactions of the Sixth Congress on Large Dams—held in New York City in September 1958—will be available this fall. The five-volume set, announced by the U.S. Committee on Large Dams, contains 4,000 pages. The cost of the five cloth-bound volumes in 16 by 25-in. format will be around $75. Orders should be sent to the U.S. Committee on Large Dams, c/o Engineers Joint Council, 29 West 39th Street, New York 18, N. Y.

The first three volumes contain the corrected text of all the Congress papers (there are 138 of them) in the original, with summaries in English and French, the official languages of the Congress. They also include the general reports and reports of the technical discussions and of speeches presented at the opening and closing sessions. This material is also given in both English and French. Volume IV consists of "Communications," and Volume V is devoted to the Index.

New Daniel W. Mead Prize Contest Open

Topics for the 1961 Daniel W. Mead Prize competition have been announced by the Committee on Conditions of Practice. This year contestants for the Associate Member Award will write on "The Place of Professional Ethics in the Engineering Curriculum." The student topic will be "The Relationship of Ethics in the Legal, Medical, and Engineering Profession." The Associate Member Award is open to Associate Members of the Society in good standing who have not passed their 32nd birthday at the time of presenting their papers. The Student Award is for members in good standing of the Society's Student Chapters.

All entries in the new competition must be in the office of the Executive Secretary at Society Headquarters by May 1, 1961. To be eligible, papers must not exceed 2,000 words, and they must be presented at a Local Section or Student Chapter meeting. Only the one best paper from each Section and Chapter can be entered in the final competition.

Winners on the Zone level will receive copies of the Centennial Transactions. The Associate Member and Student Member Awards consist of engraved certificates and cash prizes of $100 and $50, respectively.

(More ASCE News on page 75)

SECOND OF A SERIES

ADVERSE WEATHER—

In the June issue, Captain Roberts discussed "wet hot" conditions, following a general introduction to this subject of adverse weather conditions. In this issue, Part 2 of the series, he discusses "wet cold" conditions. Two more parts are in preparation, dealing with construction problems in parts of the world where "dry hot" and "dry cold" conditions govern.

2. Arctic and subarctic areas:

Wet cold conditions

PALMER W. ROBERTS, F. ASCE

Captain, CEC, U. S. Navy

Commanding Officer

Public Works Center

Guam, Marianas Islands

In considering cold-weather operations, it would be hard to find a field of human knowledge in which the past contains so many practical guideposts for the present, so much practical knowledge on which plans for the future can be based. Construction operations in the cold regions under consideration do not vary greatly from those in more temperate zones.

It is important to emphasize that the logistic implications of operations in the cold-weather regions are more serious than in any other areas. Little natural material is available for construction. Materials must be transported by vessel during the period when the shore is free of ice. As an example, at Point Barrow, Alaska, or at Thule, Greenland, this condition prevails usually from early August through mid-September. After that, all materials must be delivered by air.

There are no railroads or highways north of Fairbanks in Alaska, or Churchill, Manitoba, in Canada. Overland transportation north of these points is by sled tractor train or by rubber-tired freighters. Winter and summer, the airplane remains the most dependable means of transportation throughout the northern regions. To the airplane, the time of year means nothing, as planes can be equipped with skis for landing on snow, with skis or wheels for runways, or with pontoons for water.

Increased construction activity involved in developing and maintaining base camps, landing fields, heavy tower foundations, oil and mining operations and communications, as well as the Dew and Pine Tree Line facilities has focused attention on the engineering problems encountered. There are, however, certain variations in field practices, construction methods and engineering design necessary to meet the conditions imposed by climate, terrain and other local conditions. In approaching such problems, the environmental factors of the area must be accepted, and design, materials and construction techniques modified accordingly. The effective use of the limited resources and of the natural conditions greatly influence the application of engineering principles. In brief, here it is always necessary to work with nature and not against it.

1. Permafrost. The balance that nature has established must not be upset. The first environmental factor to be considered is permafrost or permanently frozen ground. The first American to document this problem with any degree of authority was Dr. S. Muller. His initial writing was basically a summary of Russian papers combined with his own experience while working jointly for the U. S. Geological Survey and the U. S. Army during World War II. His book, *Permafrost*, became the springboard for the consideration of the subject in this country. Since that time, the existence of permafrost at depths varying from 1,600 to 1,900 ft has been verified by well drilling in the

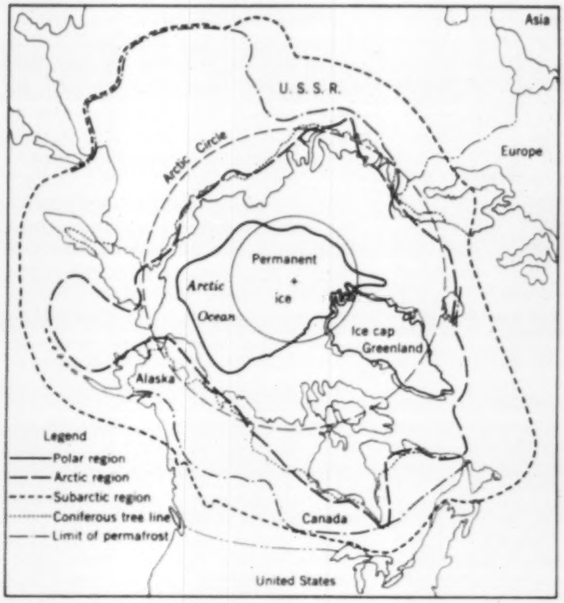


FIG. 1. The northern regions of the world vary greatly in cold conditions and in their effect on engineered construction.

Eskimo drives a heated nail. Eskimos have proved to be friendly and they become dependable workmen.

North American Arctic, which has disclosed a solid mass of frozen ground extending downward 1,900 ft from the surface.

In the area lying between the Brooks and Alaska ranges, there is a permafrost fringe zone. Here areas of frost-free ground are interspersed with permanently frozen ground. It is important to note that the supporting value of frozen ground is very high and should be utilized. Construction plans must be drawn to incorporate and maintain the thermal regime of permafrost. The stresses developed in frozen ground may exceed 28,000 psi. Few construction materials are known that are capable of withstanding the terrific mechanical pressures caused by ice formation and the accompanying increase in volume.

2. Soil studies. Soil studies are essential and must be made carefully before a site is approved. In the arctic, ridges and old river terraces located inland, and former beaches along the coast, provide the most likely sites for facilities from the standpoint of soils. Soils are not deeply weathered and their water content may be as high as 85 percent on the arctic slopes.

3. Site selection. Sites to meet even essential requirements may not be readily available. In most cases it will be possible only to meet minimum operational needs by fully utilizing the natural features of a site. Preliminary studies and advanced ground reconnaissance should be made both in winter and in summer to assure that the necessary operating requirements can be met; that the site provides adequate space for buildings and storage; and that, if it is on a sea coast, a suitable landing beach is available. At this time full consideration should be given to construction-schedule requirements. The site should present minimum problems of maintenance and transportation for both winter and summer operations.

4. Base layouts. Several factors must be considered in making base layouts—soil characteristics, the character of the permafrost, the runoff of water in early summer, adequate water supply and drainage, and the availability of local labor and materials. The average wind velocity of 12 miles per hour, and the light, continually migrating snow, establish criteria for snow removal. The street pattern and building alignment should be in the direction of the prevailing wind to minimize drifting and collection of snow.

5. Planning the job. In making preparations for construction, the following should be carefully considered:

The construction schedule must take all adverse weather factors into account.

The time element interposed by permafrost considerations should be reviewed.

Construction priority should make possible the early use of such permanent facilities as barracks, mess halls, shops and storage buildings by the construction party.

Usually all materials except aggregate must be imported.

Only supervisors with previous construction experience under conditions of extreme cold should be selected.

Almost any personnel properly trained and equipped can be adapted to such working conditions provided they have the will to do so. Eskimos have proved to be dependable for tasks they can understand or have been trained for. The entire history of successful northern exploration and operations is a story of the friendliness and assistance of the Eskimo.

6. Housing. The size and permanence of the facility, the time construction must be carried out, the availability of materials, and the construction methods adopted are factors that must be evaluated before building plans are prepared. Buildings for use in the arctic should be selected after a consideration of three factors: (1) the length of time the buildings are to be occupied; (2) the time required for their construction; and (3) the materials to be used, whether local or imported. Much work has been done in developing structures for northern regions. Many suitable types of buildings are available.

Special procedures for workmanship and for the handling of materials are required. Tight construction and good workmanship are essential. Even tiny cracks left in buildings will admit quantities of snow during high winds. All buildings must be properly insulated, using moss, fiberglass, foil, or rock wool. In heated buildings, vapor barriers are required as inadequately insulated walls will tend to sweat. Double windows are a necessity, both

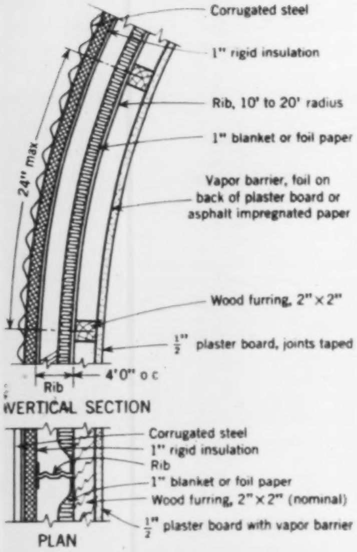
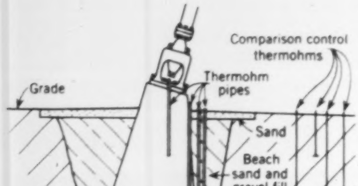


FIG. 2. Typical section through Quonset Hut for use at Point Barrow, Alaska. Heat transmission data are given below.

Item	Material Resistivity Factor, r	
Outside surface	0.17	0.17
Corr. steel	0.10	0.10
Air space (average ⅜ in.)	0.64	...
1-in. insulation board	3.03	...
Air space	0.91	0.91
1-in. blanket-type insulation	3.03	3.03
Air space	0.91	0.91
½-in. plaster board	0.23	0.23
Inside surface	0.61	0.61
Total resistance, R	9.63	5.96
Total conductive factor, $1/R = U =$	0.103	0.168

Conductance factor, U, gives heat loss per square foot of surface through the construction in Btu per hour per degree of difference between inside and outside temperatures, Fahrenheit.

FIG. 3. In heavy tower foundations it is necessary to preserve and restore the thermal equilibrium at earliest possible time. To accomplish this, the pad should be insulated and backfill installed immediately. Thermohm pipes are for temperature determination as indicated in several areas.


Comparison control thermohms
Thermohm pipes
Grade
Sand
Beach sand and gravel fill
Sand
Fiberglass
Sand
Permafrost
9 steel casings, 8" dia, 30' long

to conserve heat and to eliminate ice formation on the pane. Double doors with storm entrances are needed both to maintain an air lock and to provide a space in which excess snow can be removed from the clothing.

Lower output from workmen must be expected when the temperature falls below −20 deg F. Carpentry work can be carried on if lumber is sawed at lower cutting rates and if nails are heated and driven by a carpenter wearing light cotton gloves.

7. Foundation design and construction. The design of foundations will depend on the type of structure, the texture and thickness of the frozen ground, the behavior of the active layer, and the hydrologic and temperature regime of the ground. Masonry and continuous foundations are not recommended in permafrost. All loads for large structures should be carried on footings, piles or columns set well into the permafrost. The depth of the footing should be greater than twice the thickness of the active zone (that is, the depth to which the ground thaws in summer).

The materials on which foundations must be placed may consist of a mixture of silt, sand and vegetable matter, with a water content varying from 30 to 85 percent, and frozen to temperatures as low as 8 deg F. This material is overlaid by moss or tundra which may vary in thickness from 4 to 8 in. Structures built on permafrost ordinarily require piling foundations of steel, wood or concrete. In areas where dependable gravel deposits are encountered, adequate mud sills may provide suitable foundations.

8. Airfield and highway construction. In cold-weather areas it is important to classify airfields in three general categories: ice airfields, light airfields, and heavy airfields.

Ice airfields are located on ice caps and frozen lakes and involve construction of a temporary nature, when quick missions and rapid construction are required. Occasionally fields are built on ice in the polar region. The main consideration is to select a site suitable for the mission, with a surface that is relatively smooth so as to minimize the amount of grading or surface adjustment required. Actual methods of leveling may involve unorthodox procedures such as snow compaction or the building up of surfaces with water.

Light airfields or small commercial airfields usually must be constructed in a minimum of time with a minimum of effort. The site must be selected carefully to satisfy flight characteristics and to meet the needs of logistic support and rapid or low-cost construction.

Heavy airfields or commercial airfields present the main problems in planning, field studies, material and construction effort, and a need for heavy equipment. Runways can be constructed only during the summer. Large areas are worked at one time so that the heat of the sun can be utilized to thaw the material as rapidly as excavation proceeds. The average rate of thaw in the summer varies from 4 to 6 in. per day. When the thawing rate is slow, it is sometimes necessary to utilize steam points or hydraulic methods.

Erection of snow fences is usually found to be impracticable because of the constant shifting of snow and the volume of material involved. The most satisfactory method is to align runways with the prevailing winter wind and elevate them slightly above the surrounding area. This design helps to maintain the needed wind velocity and grade for natural snow removal. Thus, during a snow storm, constant dragging of a runway keeps the snow loosened and the wind carries it away. Mechanical methods of handling snow have been widely used and found to be the most successful. However, snow must be handled shortly after it falls, because within 24 hours, as a result of natural compaction, it becomes very hard.

While the construction of roads is similar to that of runways, other problems are also involved. Where possible, roads should be located on the south side of slopes, as (1) the ground there is more likely to be thawed and free from permafrost, (2) the construction schedule will benefit from an early spring thaw and a later fall freeze, and (3) maintenance problems will be reduced because of lighter snows and less winter ground ice. In road construction in the north, it is important to avoid through cuts that induce drifting and glaciation.

9. Sanitation. In cold-weather areas, biological and chemical reactions are retarded and the physical states of fluids, soils and materials are appreciably different from what they are in temperate areas. The soil does not assimilate waste as readily under conditions of low temperature. Therefore unusual problems are presented in the disposal of garbage and other refuse. Most waste disposal methods consist of the old primary method of collecting refuse from chamber pots and burying it in cans with garbage in sanitary fills. Along the coast it may be left on the ice to be carried away when the ice moves out in the summer. Pit or surface privies have been used but are considered impracticable because of the lack of drainage in the soil.

Septic tanks and subsurface tile

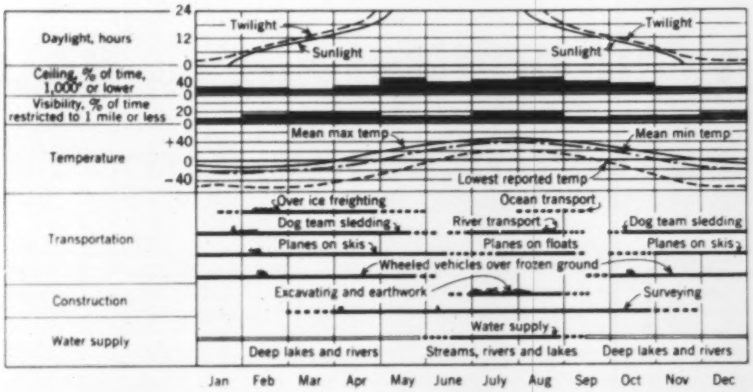


FIG. 4. Cold, wet—and sometimes dark—conditions at Point Barrow, Alaska, Lat. 71°, Long. 196°, El. 10. From a Work Feasibility Chart for a U. S. Navy Bureau of Yards and Docks project.

fields also may prove unsatisfactory, as the entire system may remain frozen during much of the year. In some places, artificial heating is employed for modern systems, which under these conditions have been operated successfully. In communities adjoining rivers, facilities for water-born sewage may be constructed utilizing heated sewage-disposal units and utilidors for handling the sewer services. The effluent from such systems is usually chlorinated and discharged below water into streams or rivers, or directly into the sea.

10. Water supply. Water supply is one of the most serious problems that must be considered in areas of extreme cold. The melting of snow and ice for a water supply demands large quantities of fuel, is expensive and inefficient. It should be relied on only for small parties or in an emergency. The most dependable water sources are deep lakes and rivers having adequate reservoir capabilities or flow below the maximum freezing depths. It is therefore necessary that installations be located near such dependable sources of water.

11. Construction equipment and tools. Most construction equipment must be adapted to use in extreme cold weather unless the work is to be accomplished during the summer. Equipment must be winterized and proper lubricants provided for temperatures below −55 deg F. Requirements for spare parts should be carefully studied, and items that are likely to fail in cold weather should be adequately stocked or replaced. Hand tools should be provided in quantities 50 percent to 100 percent greater than is usual for construction in temperate zones. Covered storage and repair facilities for equipment must be included if year-round operations are contemplated.

12. Concrete handling. The problem of producing concrete of the quality specified in design, from the materials available under conditions of extreme cold weather, is one of job environment control. Aggregates that meet the requirements for hardness and toughness are usually available and limited only by the desired shape, size and gradation of particles. The most dependable and readily available natural sources of aggregates are river banks and old terraces, sand and gravel bars, river deltas, and coastal beaches.

For all work, high-early-strength cement that meets the specifications of the American Society for Testing Materials is recommended, as concrete made with it need not be heated so long for curing. Cement should be double-bagged in heavy, durable bags and palletized to minimize in-transit and storage damage. The use of admixtures, while not harmful if carefully and judiciously controlled, should not be relied on to prevent freezing in extreme cold.

Increasing the temperature of concrete in cold weather is commonly accomplished by heating the aggregates or the water or both. Mixing water is usually heated by live steam or by heating coils. The temperature of the water should be held between 90 and 120 deg F. Because of the danger of causing a flash set of the cement, water temperature should not exceed 165 deg F.

Concreting can be successfully accomplished in cold weather without decreasing the final quality of the product. However, strength develops slowly at low temperatures. If actual freezing is prevented during initial setting, and if supports are left in place until the concrete has reached a compressive strength of 1,500 psi, there should be no concern as to the effects of low temperature on the quality. Newly poured concrete should be covered and heated by steam, hot air or stoves during curing. If dry heat is used, the concrete must be kept moist to prevent drying cracks.

13. Work feasibility chart. The factors of weather can be carefully analyzed and combined in graphic form with the work to be accomplished to provide a dependable seasonal work-feasibility reference chart. For example, such a chart for February at Point Barrow, Alaska, will show that:

Daylight increases from 3 to 9 hours per day.

Ceiling is 1,000 ft or less 19 percent if the month.

Visibility is one mile or less 14 percent of the month.

Temperature maximum is 35 deg F and temperature minimum, −56 deg F.

Wind speed is 71 mph maximum and 14 mph minimum.

Ice thickness in rivers and lakes is 48 to 54 in., and in the ocean, 40 to 50 in.

This chart indicates that:

Over ice and over land freighting can proceed with tractors and sleds provided all equipment has been completely winterized.

Airplanes can operate on skis, the flying time being limited by the short period of daylight.

Lakes and rivers are frozen, so that water can be taken only from lakes over 5 ft deep.

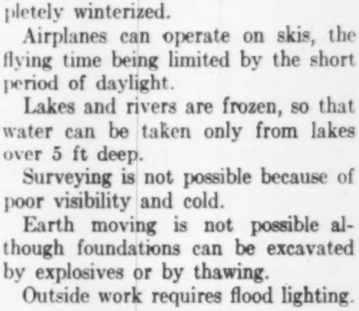
Surveying is not possible because of poor visibility and cold.

Earth moving is not possible although foundations can be excavated by explosives or by thawing.

Outside work requires flood lighting.

(Later issues of Civil Engineering *will feature articles by Captain Roberts on "dry hot" and "dry cold" conditions of adverse weather. This discussion of "wet cold" adverse weather conditions was originally presented by him before a January 1960 meeting of the Metropolitan Section of ASCE in New York.)*

FIG. 5. Effect of temperature on the compressive strength of concrete during first 28 days.



Well points win dewatering battle in sewer tunnel

GILBERT M. TURNER, President, Texas Tunneling Company, Houston, Tex.

W. D. MURPHY, A.M. ASCE, Vice President, Boring & Tunneling Company of America, Houston, Tex.

Twenty-seven men, working three shifts a day, six and seven days a week, fought water, gravel and running sand to complete an 1,800-ft length of tunnel for the new Round Barn Sanitary Sewer in Richmond, Ind. Five shafts ranging in depth from 30 to 72 ft from the surface gave access to the level where a half-circle shield was used to drive a tunnel of 60-in. diameter, in which 36-in. pipe was laid.

From the very start of the job, unexpected difficulties were encountered by the Texas Tunneling Company of Houston, Tex., a division of the Boring & Tunneling Company of America. Preliminary test bores had shown that the water table in the sand and gravel was about a foot above the tunnel invert. However, the wettest year in recent history raised this level to 10 ft above the tunnel invert. Previous plans to handle the water by sumping had to be junked.

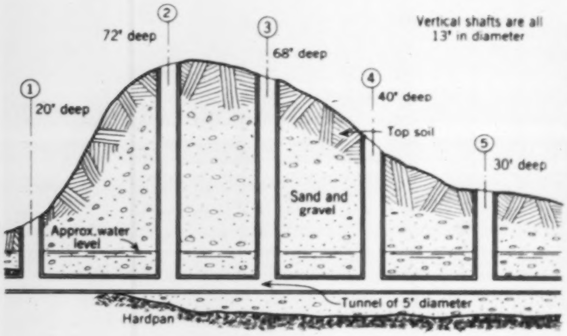

72' deep
68' deep
20' deep
40' deep
30' deep
Vertical shafts are all 13' in diameter
Top soil
Sand and gravel
Approx. water level
Tunnel of 5' diameter
Hardpan

FIG. 1. Schematic cross section shows 1,800-ft length of sewer tunnel in which dewatering problem was acute. Extraordinary amounts of water had to be drawn out of sand and gravel formation to dry out the tunnel line for construction.

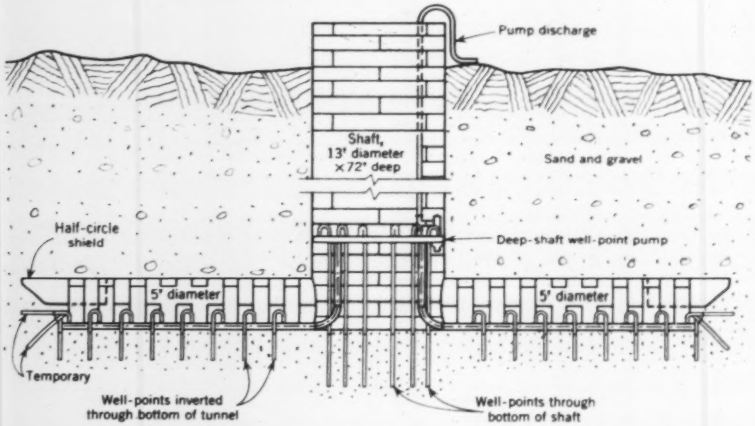

Pump discharge
Shaft, 13' diameter × 72' deep
Sand and gravel
Half-circle shield
Deep-shaft well-point pump
5' diameter
5' diameter
Temporary
Well-points inverted through bottom of tunnel
Well-points through bottom of shaft

FIG. 2. Moretrench well points installed through the bottom of the shafts lowered water so that tunneling could be started, but points had to be advanced with the horizontal excavation.

Plans were initiated to lower the water table by the use of deep-well turbine pumps. The first well was drilled near a shaft and an 8-in. turbine pump was placed in operation. After pumping for several days with no appreciable effect along the tunnel line, a second well was drilled at the next shaft 500 ft away and a third well on the tunnel line half way between the two shafts. The second and third wells were equipped with 10-in. turbine pumps.

Deep-shaft pumps ordered

Although large volumes of water were removed, after 30 days of constant pumping the water level had been lowered only about 2 ft. It became evident that the deep wells could not do the job in the time allocated. The Moretrench Corporation was then called in for consultation. It recommended the use of deep-shaft well-point pumps, to be installed in the shafts and connected to a cluster of well points installed in the bottom of each shaft to lower the water at the shaft location. A second purpose was to furnish pumping for additional well points placed within the tunnel limits as the work progressed.

Three deep-shaft pumps, designed and built by Moretrench especially for this job, were ordered. One was placed in the first shaft, one in the next shaft and one held as a standby to be used as conditions required.

The pump and the header pipe fabricated for installation in the shaft were placed 62 ft below the surface. Pumping over a week end lowered the water sufficiently so that additional well points could be installed to take it below the tunnel invert.

Unseasonal rainfall

The job was constantly hampered by unseasonal rainfall. Normally rainfall is not a factor in a tunnel operation because of the depth underground. However, in this case a 1-in. rain on the surface would raise the water level in the tunnel by as much as 18 in. in three hours with all the pumps working. In excess of 100,000 gal per hr was removed from the underground strata. This phenomenon brought a lot of head scratching from all concerned. The only logical explanation was that the upper surface of the hardpan, located a few feet below the tunnel invert, was in the form of a huge geologic bowl. This trapped the rainfall from a large area as it filtered down almost unhindered through the loose sand and gravel to form a huge underground lake. The overburden was so loose in some places that tunneling without a shield would have resulted in movement all the way to the surface.

The toughest part of the job was a 500-ft section where hardpan was close to the bottom of the tunnel. Well points, installed through the tunnel invert, were unable to lower the water. In this section, as well as in parts of the other sections of the tunnel, the water that was not removed by the well points flowed to the shafts, from which it was pumped to the surface by high-volume centrifugal pumps designed for the job.

Threat of caving

During excavation of the lower part of the shafts, the constant threat of caving of the sand and gravel caused the contractor to decide on the use of a shield for tunnel driving. Half-circle shields, powered by hydraulic rams, were secured from the Osborn Machine Company of Houston, Tex. Using well points in the face and jacking the shield ahead, the crews hand mucked the sand and gravel into Osborn-built muck carts. These were pushed from the tunnel to the shaft on mine-car rails, then hoisted to the top with a ¾-cu yd Unit crane. The contents were dumped on the ground for subsequent removal.

The crews made slow and painful progress for days that stretched into weeks and then months. By working around the clock six and seven days a week, they completed the job within the allotted time despite the unusual conditions.

Liner plates for shafts and tunnel

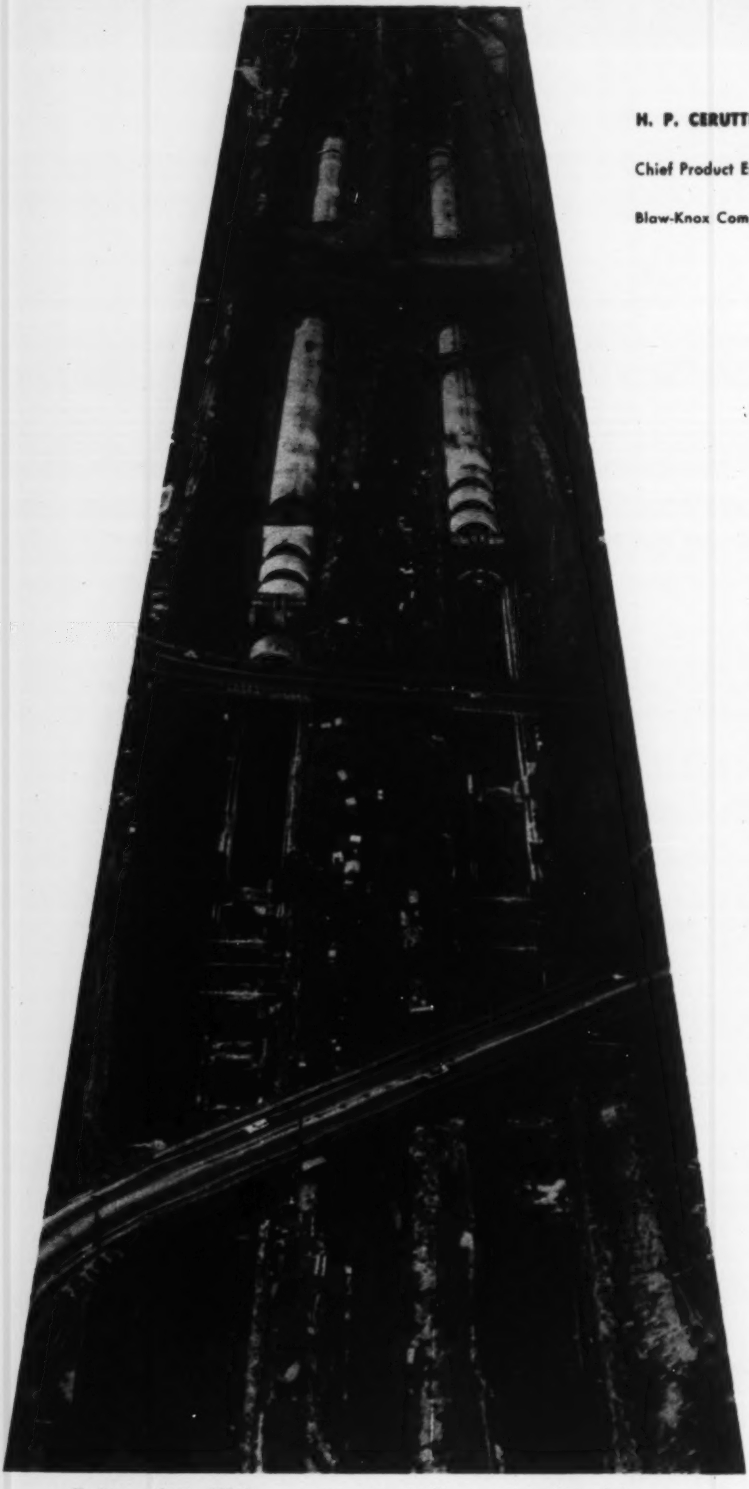
For fast and safe excavation, the five access shafts, of 13-ft diameter, were lined with tunnel liner plates. As excavation proceeded downward, the liner plates were successively secured in position to provide a safe and unobstructed shaft. From each shaft, a tunnel of 5-ft diameter was driven and lined with liner plates installed as the excavation progressed. The tunnel liner plates for the shafts and tunnel were supplied by Truscon, a Division of the Republic Steel Corporation. Reinforced concrete pipe of 36-in. diameter was installed inside the tunnel liner, and the void remaining between the pipe and the liner was filled with grout. The shafts serve as manholes for the completed tunnel.

Henry B. Steeg and Associates were the engineers on the project. Edward Ross, as Plant Superintendent, represented the City of Richmond, Ind. The general contractor was R. G. Mattern, Inc., of Dayton, Ohio. Jerry Free was superintendent for the Texas Tunneling Company.

Looking down into a shaft of 13-ft diameter lined with Truscon plates.

A Unit crane lifts muck from a shaft and dumps it at left for later removal. Osborn-built muck carts were pushed from the tunnel to the shaft on mine-car rails.

TWIN CONDUITS FOR NIAGARA



Twin conduits 200 ft on centers are built on succession of forms. Backfilling over finished conduit has started in background.

H. P. CERUTTI

Chief Product Engineer and Manager of Sales-Heavy Forms

Blaw-Knox Company, Pittsburgh, Pa.

Mammoth concrete conduits are being given a horseshoe shape through the use of specially designed steel forms by three contractors in a major phase of the Niagara River Power Development at Niagara Falls, N. Y. These underground twin conduits—each 22,600 ft long, 46 ft wide and 66 ft high—will carry water from the Niagara River, three miles above the Falls, into a mile-long forebay and surge basin, leading to the world's largest power plant and a pump-generating plant for greater utilization of the off-peak flow of the river.

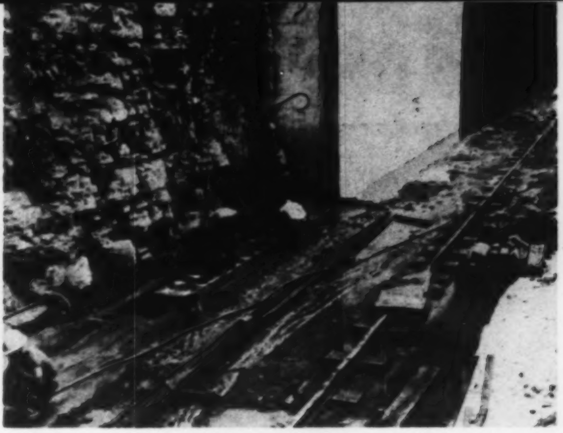
Contractors in this conduit work are Merritt-Chapman & Scott Corporation of New York, N. Y.; Balf, Savin & Winkelman of Hartford, Conn., a joint venture of the Edward Balf-Savin Construction and the D. W. Winkelman Companies; and Gull-DeFelice, a combine of Gull Construction Company of New York, N. Y., and L. G. DeFelice & Son of North New Haven, Conn.

All three of these contractors are using slab forms, wall forms, haunch and inside and outside three-hinged arch forms—all designed and fabricated for the job by Blaw-Knox Company, Pittsburgh, Pa.—to place more than 1½ million cu yd of concrete.

All the contractors are using essentially the same method of operation in concrete placement because they are working in channels of exactly the same size and using the same type of Blaw-Knox forms, custom built for the job, according to one of the contractors. The forms have been a tremendous asset on all three phases of conduit work—meeting rigid concreting specifications and pacing work schedules.

The two parallel tubes, 200 ft apart, are being constructed by the cut-and-cover method with a maximum depth of nearly 200 ft required in one area. The rock was line-drilled, and special care was taken to avoid shattering it

Half-round concrete drains, formed and ready for concrete, can be seen under reinforcement in slab section.



A lead sheet 1/16 in. thick and 24 in. wide goes on the base section to permit movement if the rock should squeeze.

during blasting. Uhl, Hall & Rich, an engineering subsidiary of Charles T. Main, Inc., Boston, designed the flexible conduit, the top of which averages 40 ft below ground. The squeeze effect of possible rock movement resulting from excavation for the conduit, and the release of locked-in stresses in the sidewall rock, was provided for in the arch design. To date there has been movement only in isolated areas, and this is measurable only in hundredths of a foot. It is not expected to create any problem.

The bottom slab, 2 ft 6 in. thick, is constructed to allow a clear space of 9 in. between the concrete and the unexcavated rock on each side. The sidewalls, with a minimum thickness of 2 ft 6 in., are cast against the rock and tied into it with heavy rods doweled into the sides. The wall is built above the slab, care being taken to keep broken rock or other debris out of the 9-in. opening along the slab.

A special feature is the use of sheet lead 1/16 in. thick and 2 ft wide as a sort of gasket at the bottom of the 66-ft-high walls. It serves as a lubricant to permit sliding and as a seal to ensure watertightness. First the slab surface is painted with an asphalt emulsion, then the lead is laid flat. A coat of emulsion is placed over the lead to prevent reaction with the free lime in the concrete that is to be placed directly on it.

At the top of the vertical section of the walls, the trench widens 5 ft on each side to provide for an arch abutment and hinge near the springing line. Arch concrete varies in thickness from 6 ft at the abutments to 4 ft 6 in. at the crown. The hinge is formed by a metal plate across the entire concrete thickness. The plate at the abutment has a dip of 15-in. radius and the plate at the crown is made with a groove of 12-in. radius and set vertical. The bottom of the groove is smeared with Carnak, which serves as a watertight lubricant. Outside the groove, expanded polystyrene sheets (Styrofoam) are used on each side of the joint to provide a permanently live material that will permit movement should the rock squeeze or spread and the arch change. The Styrofoam is 1¼ in. thick on the compression side of the joint and a little thinner on the tension side.

To prevent possible uplift of the big conduits when empty, drainage is provided longitudinally under the floor slab for the full length, with frequent laterals to the sides of the excavation. To prevent hydraulic pressure against the sidewalls, vertical drains are provided about every 10 ft. The original plan was to use half-round concrete pipe but the fastening of this to the rough rock wall presented a serious problem. An excellent alternate was found in the form of an air-expandable Voidcrete rubber tube, which is placed roughly vertical along the wall. Ordinary fly screen is placed over the tube and nailed to the wall. This assures better drainage over an area larger than that of the planned concrete half-round pipe. The screen also keeps concrete off the tube. Withdrawal of the tube from inside the screen is made easy by deflating it from a diameter of 5 or 6 in. to that of about 4 in. Dumbbell-shaped flexible waterstops are used at joints throughout the structure.

This is a general description of the structure that is to be built for the full length of the conduits, all done with Blaw-Knox forms. The forms arrived on the job "knocked-down" and were assembled at the site into units for placing monoliths 40 ft long.

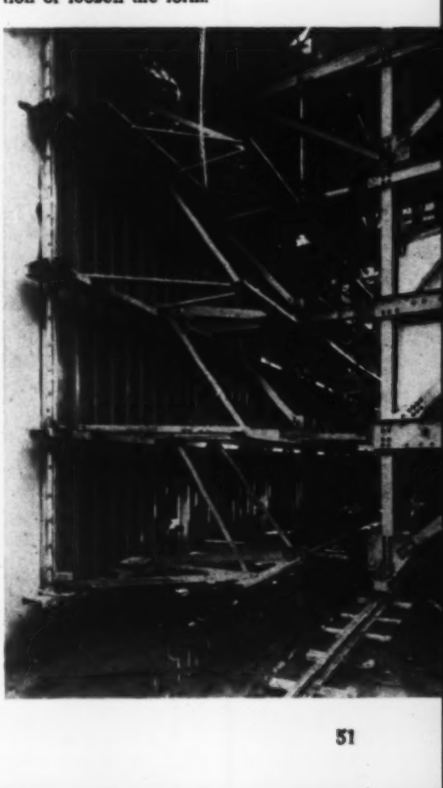
Typical of the horizontal erection methods was that used by the Merritt-Chapman & Scott Corp. Forms were assembled in a yard near the conduit channels and moved on a trailer of 100-ton capacity. At the channel sites, forms were tilted upright and lowered into position with a crane of 80-ton capacity equipped with a 100-ft boom. The forms were erected and positioned "just in line" with anticipated costs.

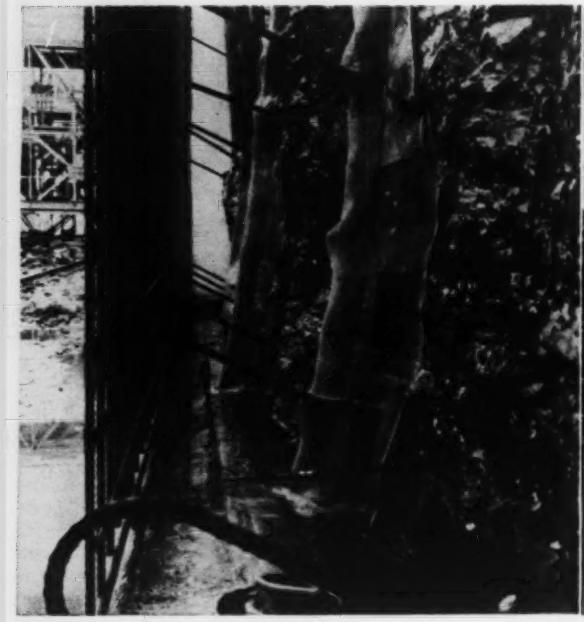
Although the contractors differ on assembly procedures and some phases of construction, all three are close to schedule on the $100 million conduit phase of the power development project.

Merritt-Chapman & Scott, Section 1

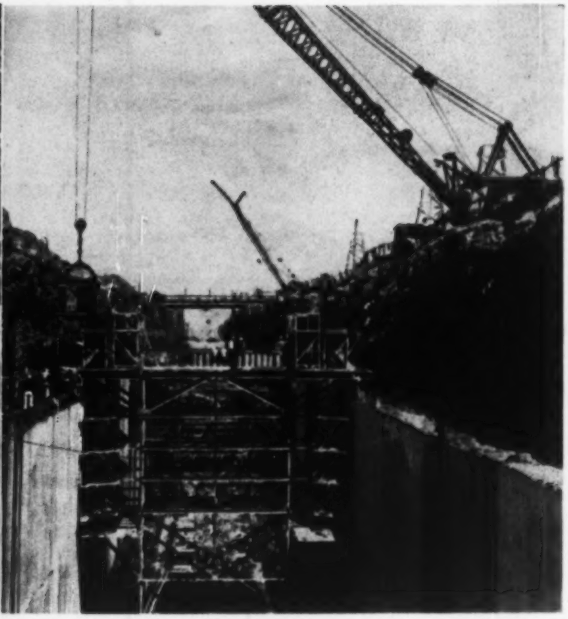
Merritt-Chapman & Scott is building the river intake structure and the first 8,000-ft section of twin conduit. The construction contract on the two projects totals $66 million.

First lift of Blaw-Knox forms is ready for concrete. Hydraulic jacks quickly position or loosen the form.





Fly screen covers an expandable rubber tube to provide a dependable vertical drain.

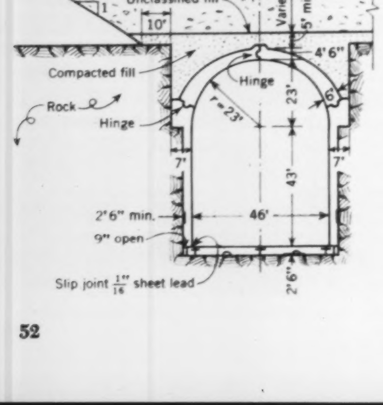


Concrete is placed by crane for second lift of wall. Forms are carried by and positioned from Blaw-Knox traveler.

Water will enter the intake 25 ft below river level, flowing into the conduit at a rate of 83,000 cfs with a velocity of 14 fps. Conduit mouths will be closed, when necessary, by two 49-ft by 68-ft gates, housed in towers 96 ft high.

In concreting the 2½-ft-thick bottom-slab section of the conduit, Merritt-Chapman & Scott places blocks in a checkerboard pattern, making alternate pours to speed operations. The slab is placed in 22- by 40-ft sections; wall footings 2 ft 9 in. wide complete the 46½-ft slab width. Four forms are used to concrete one lead slab and only three forms for the other lead slab, using checkerboard placement. A section between two finished slabs requires only two side forms, and when three sides of a slab are finished, only one section of form is required.

FIG. 1. Cross section through a conduit for the Niagara Power Project.



Crews need only two hours to set the forms for one section of slab. Eight forms are set in a day—four in each channel—and 80 lin ft of concrete are placed the next day. Concrete sets 24 hours before forms are stripped and repositioned. Rails for traveling scaffolds and form gantries are laid on the slab.

Merritt-Chapman & Scott employs two lower-lift working scaffolds 21½ ft high, two second-lift working scaffolds 43 ft high, six lower-lift wall forms mounted in pairs on three gantries, six second-lift wall forms, six haunch forms, eight lower arch forms, and four outside arch forms. All are in 40-ft lengths. Each wall form is used for each third monolith, moving longitudinally without passing.

Blaw-Knox traveling scaffolds are used to prepare walls for concrete placement. Solid rock walls are cleaned, holes drilled to accept anchor bars, and No. 11 (1¼-in.) reinforcing bars set in place.

The wall forms, 21½ ft high for each lift, are rolled into position on tracks by an air-operated winch, and set by hydraulic jacks to exact face alignment. A hinged bulkhead swings into place to make the end form. Concrete from a central plant is hauled in 4-cu yd buckets by trucks and swung over hoppers for elephant-trunk delivery to the forms. Concrete is placed for one side wall and then for the other to reduce the hazards of unbalanced pressure. After a setting period of three days, the form's jacks are backed off, pulling the form 6 in. out from the wall to permit moving it to the next position. As soon as the concrete is exposed, it is sprayed with a white pigmented curing compound.

Both lower and second-lift wall forms are moved on a four-day schedule; three days are allowed for the concrete to harden and the fourth day is used to move and align the forms. Actually the forms are moved and set in one hour. The rest of the fourth day is spent on miscellaneous carpentry work.

After the second-lift wall is completed, the haunch form is positioned. This form is equipped with bulkheads and a hinged top section. The Blaw-Knox steel unit measures 7 ft in base width. Its outside height is 10 ft and its inside height 6 ft 11 in.

Arch concreting requires an eight-day period. Concrete must be supported for six days. Four 30-ton jacks are used to lower the inside arch forms, and four jacks of similar capacity to free the outside arch forms from the concrete when it has set. Two days are required to move the forms forward, set 53 tons of reinforcing steel, and prepare for the placing of 500 cu yd of concrete. The finished arch has a thickness of 6 ft 1⅞ in. at the base and 5 ft at the apex.

The components of six complete conduit blocks, that is, a 40-ft section of floor, wall, haunch, and arch, are built in eight days. All of the 550,000 cu yd of concrete for the conduit placed by Merritt-Chapman & Scott is being supplied from the firm's own central plant, which has a capacity of 192 cu yd per hour.

Balf, Savin & Winkelman, Section 2

Using identical Blaw-Knox forms, Balf, Savin & Winkelman is placing 608,500 cu yd of concrete to construct the 9,000 ft of twin conduit in Section 2. This $37.5 million phase of the project required cuts to a depth of 122 ft, and excavation of more than 5 million cu yd of earth and rock.

This contractor is placing 12 blocks a week, making "pours" in four separate locations. In use are 34 Blaw-Knox forms—including four outside arch, 12 inside arch, four haunch, four second lift, four lower lift, and six slab units. Wall and haunch forms are repositioned three times a week. Top arch forms are stripped in 24 hours while bottom arch forms remain in place six days. Slab forms are stripped in 24 hours.

Concrete is supplied from a batching plant with a capacity of 200 cu yd per hour and hauled to the placing site in 8-cu yd Dumpcretes, which are emptied into 4-cu yd Blaw-Knox concrete buckets. The buckets are designed low to permit working with Dumpcretes. Suspended from cranes equipped with 100-ft booms, the buckets are lowered to hoppers. Concrete is placed from hoppers into the forms.

Use of the specially designed Blaw-Knox steel forms has already netted Balf, Savin & Winkelman a 35-percent saving in assembly time. Trained crews erect the wall forms in four to five days. Only 17 percent of the contractor's work force is required to set up the forms and move them from one concreting position to another.

Gull-DeFelice, Section 3

Gull-DeFelice has a $32.5 million contract for construction of 5,600 ft of twin tubes. The contractor has assigned only 15 percent of his work force to handle 34 Blaw-Knox slab, lower, second-lift, haunch, and arch forms.

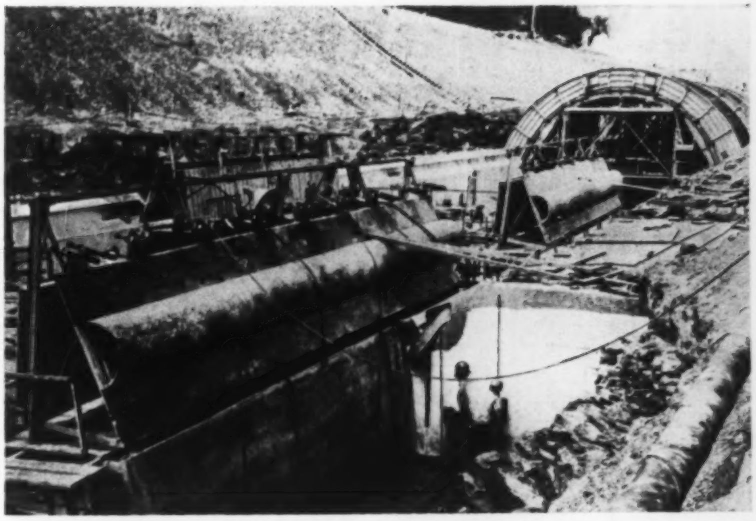
From 4 to 12 hours are used to position the forms, to complete related carpentry work—such as fitting the side panels to irregular lines of rock—and to place the concrete. Curing time for wall concrete is 72 hours while outside arch and slab forms are stripped in 24 hours. Inside arch forms remain in position for six days.

Gull-DeFelice will place a total of 448,000 cu yd of concrete in constructing this third conduit section, which leads into the mile-long open canal of the Niagara Generating Plant. Concrete from a central mix plant of 250-cu yd capacity is moved to the working site in 15 Dumpcretes, which feed into 4-cu yd Blaw-Knox buckets working from cranes with 100-ft booms.

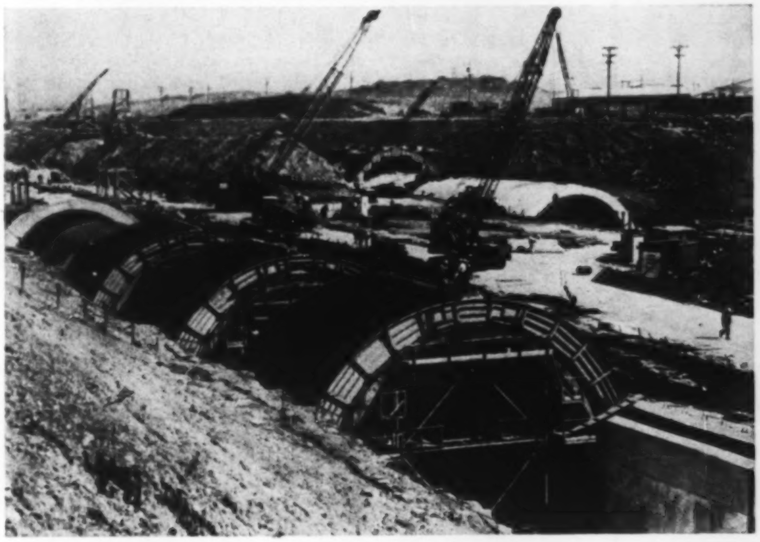
Concrete placing in this section is more difficult than in Sections 1 and 2 because of the conduit channel depth. The rock rises and the conduits are sloped 0.3 percent to the discharge end. The excavation depth, and the depth to which some concrete must be lowered, is nearly 200 ft.

In addition to the conduit work, Gull-DeFelice has contracted to complete an underwater pump station just south of the conduit outlet, stop-log and transition structures, and an electrical switchyard.

Power is scheduled to go on the line February 10, 1961. Since there is a lot of work to be done on the conduits and the power plant, construction will continue on a rush schedule through all of this year.



Haunch form has special top to form hinge of arch. Note dumbbell type of water strip coiled on preceding pour.



Four arch-support forms are seen in varying stages of readiness for concrete. A top unit, left background, is placed to form the arch surface.

Precast, prestressed sections for Florida bridges

W. E. DEAN, F. ASCE, Assistant State Highway Engineer (Structures), Florida State Road Department, Tallahassee, Fla.

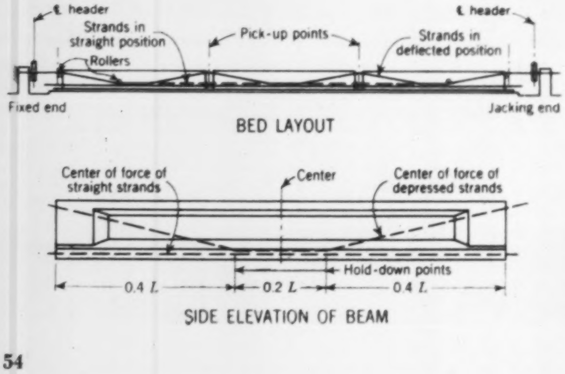
In the past nine years, the use of precast, prestressed bridge members by the Florida State Road Department has grown steadily until these members dominate the field of simple structures with span lengths from about 30 to 110 ft. About 75 percent of Florida highway bridges come within these length limits. Here precast prestressed I-sections and slab sections are used to the near exclusion of all other beam types. The precast, prestressed members are being supplied by 14 Florida plants for placing in a wide variety of standard and special bridges. To achieve uniformity of practice and stimulate active competition, it has been found essential to develop and use a limited number of simple standard sections.

In spans of about 30 to 40 ft, particularly where depth of structure is critical, the AASHO-PCI Standard voided flat-slab sections are usually used. These are generally employed in combination with a 4-in. composite concrete topping, although bituminous surfacing is sometimes used for isolated structures. This is the span range that might be served by the AASHO-PCI Type I beam. When these slab sections were first introduced early in 1959, they were bid at higher prices on several projects than equivalent spans using the Type I beams and cast-in-place deck. After some experience with the simplicity of slab construction, the price has been lowered to the point where the slabs have practically replaced the Type I beams.

The beam-and-slab superstructures which comprise about 90 percent of our prestressed bridge work use the AASHO-PCI standard I-beams, Types II, III and IV. (See Fig. 1 in Glenn S. Paxson's article, CIVIL ENGINEERING, Jan. 1960, p. 48.) Type II is normally used in the span range of 40 to 60 ft, but in special cases has been employed in spans as short as 30 ft and as long as 70 ft. Type III is normally used in spans of 55 to 80 ft and in special cases from about 45 to 90 ft. Type IV, normally for spans of 70 to 100 ft, like the other sections has had its span range extended about 10 ft in both directions.

These wide variations in span limit for each size of beam are accomplished by varying the lateral spacing and prestress reinforcing. For each size of beam, the lateral spacing varies from about 4 ft for the maximum span length to about 9 ft for the minimum. Reinforcing is designed to meet particular span requirements.

In the Florida Road Department's first attempt at standardization, in 1954, the concept of the largest beam that could be readily handled and transported to isolated locations was one about 60 ft long, weighing about 12 tons. By 1956, when the AASHO-PCI beams were developed, this limit had been raised to a beam length of more than 100 ft and a weight of up to 50 tons. The example of other designing organizations, and particularly the urging of producers, were largely responsible for this change.



℄ header
Strands in straight position
Rollers
Pick-up points
Strands in deflected position
℄ header
Fixed end
Jacking end
BED LAYOUT
Center of force of straight strands
Center
Center of force of depressed strands
Hold-down points
0.4 L
0.2 L
0.4 L
SIDE ELEVATION OF BEAM

FIG. 1. Stressing details are shown for pretensioning of draped strands.

Where water transportation is available from plant to job site, the moving of such members is no problem. Rail transportation from the plant to a point near the job site has also been used. Where highway transportation is necessary, the hauling and handling of these beams becomes more difficult. However, special equipment has been developed, including multiple-axle, steerable dollies, enabling the producers to successfully meet the challenge of delivering these large members at an economical price when, where, and in whatever quantity needed.

The use of prestressed parts from fourteen different producers made it necessary to set up an organization of inspection and testing personnel, from which at least one senior inspector was assigned to each plant. Stress transfer to the concrete is allowed only after cylinder tests have shown that the concrete has developed a compressive strength of 4,000 psi. With the high early strength mixes used and the need for early release of the stressing beds, cylinder data must be made available promptly. Thus the exclusive use of a central laboratory for testing is not feasible. We have established a laboratory equipped for cylinder testing either in or readily available to every prestressing yard so that cylinder tests can be made promptly at any age.

The prestressing method employed for perhaps 90 percent of the bridge members used by the Florida Road Department is pretensioning on long beds with seven-wire strands $\frac{3}{8}$ in., $\frac{7}{16}$ in. and $\frac{1}{2}$ in. in diameter. One enterprising contractor insists on job-site manufacture of his beams using post-tensioning. All the other contractors use the prestress method or purchase their members from established producers who use it. Formerly, the combined stressing method was much used, where straight tendons were pretensioned on the production beds and draped tendons stressed later by post-tensioning. Within the past year, however, more than half of the producers have equipped their plants for the pretensioning of draped strands, and the use of the combined method has been drastically reduced.

The general method used for tensioning draped strands is shown in Fig. 1. In the initial stressing, the cables are in the lower positions except at the ends, where they pass over rollers. In this position they are stressed to a value equal to the total required stress less the stress that will result from final draping. The final operation consists of pulling the strands upward at the ends of the beam while they are held down at the required positions within the beam. The strains resulting from this operation complete the stressing.

In draped-strand pretensioning, a considerable part of the final stress (generally from 15 to 30 percent) is induced by the strains resulting from the pull-up and hold-down operation. These strains will vary with the length of the bed and with the beam layout on the bed. For all draped-strand pretensioning, therefore, the producers are required to submit for approval of the bridge design office an exact layout of the bed and beams with calculations of the strains resulting from the trajectory of the draped cables in their final form.

Initially considerable difficulty was anticipated from friction at hold-down and pick-up points, which would result in stress differentials. To check this factor we have made literally hundreds of actual strain measurements with Whittemore gages at various points along the cables. The conclusion is that with proper yard techniques such fears are groundless. In the operation of hold-down and pull-up which follows the initial stressing, the preferred method is to carry on all these operations simultaneously. Where this is impracticable, the operations are carried on symmetrically about the center of the bed. As a result of actual strain measurements we believe that stressing accuracy can be readily obtained within 2 percent of theoretical values.

An early difficulty encountered was the release of hold-downs of the deflected strand. As the vertical forces at hold-down points are concentrated and often equal or exceed the weight of the beam, they must be released simultaneously with or following release of the horizontal end forces in the usual beam, or serious initial camber and cracking of the beam from the top down is likely. Numerous expedients have been used including counterweighting of the tops of the beams and the use of pivoted hold-downs capable of some horizontal movement when all the stress is released at one end. The most satisfactory solution

Prestressed beams of Type III carry overpass on Orlando, Fla., expressway system. In 44-ft end spans, beams are spaced 9 ft 6 in. on centers; in 78-ft center span, spacing is 5 ft 5 in. on centers.

Main structure on Miami Expressway is 36th Street Causeway, which has 65-ft and 98-ft trestle spans with prestressed beams. These beams are seen in place in lower view, showing construction under way.

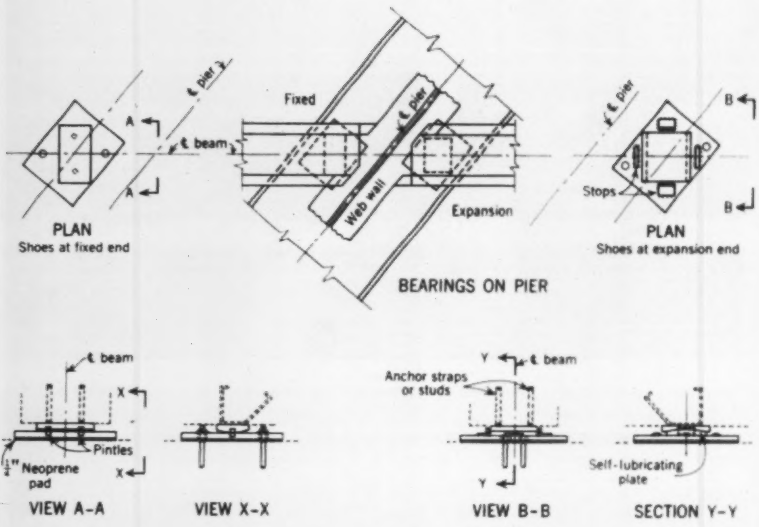

℄ pier
A
℄ beam
PLAN
Shoes at fixed end
Fixed
℄ pier
Web wall
Expansion
BEARINGS ON PIER
℄ pier
B
Stops
PLAN
Shoes at expansion end
℄ beam
X
Pintles
½" Neoprene pad
VIEW A-A
VIEW X-X
Y
℄ beam
Anchor straps or studs
Self-lubricating plate
VIEW B-B
SECTION Y-Y

FIG. 2. For large skews, bearing shoes are used with pintles at fixed ends and self-lubricating bronze plates, to permit both rotation and sliding at expansion ends.

has been to release the stress by burning the strand according to a prescribed pattern, simultaneously between the ends of all beams on a bed, after which the hold-downs are released. A large flame is used that requires 5 to 10 seconds to cut a strand. With this technique shock is minimized and destressing is kept symmetrical about the vertical axis of the beam, progressing downward from the top strands. By this means no part of the cable system is overstressed, forces are released gradually, and the beam does not slide along the bed.

Beams in lengths up to 80 ft in square bridges and in bridges skewed up to about 20 deg and on grades not over 3 percent, are set on neoprene bearing pads 1 in. thick. For gradients up to 3 percent, the top of the pier is constructed parallel to grade. Downgrade beam ends are fixed and upgrade are expansion.

For the longer spans, above 80 ft, where they are level or on a grade of not more than 1 percent, neoprene pads have been used with both ends expanding. Generally for these longer spans, for grades more than 3 percent and for large skews, bearing shoes are used with pintles at fixed ends and self-lubricating bronze plates to allow both rotation and sliding at the expansion ends. General details of shoes for severely skewed spans are shown in Fig. 2.

Bearing details for beams on neoprene pads are given in Figs. 3 and 4. Two types have been used but neither has shown any great advantage over the other. The simple dowels in the cast-in-place diaphragm with fixed ends is the cheaper detail and seems entirely satisfactory in most cases. The dowels are wrapped with roofing paper to permit a small compression and end rotation under live load. The detail with the anchor plates is preferred for superelevated spans, skews and heavy grades where longitudinal guidance and lateral restraint are needed at both ends.

One detail that formerly gave much trouble was how to secure full bearing contact between beam ends and piers. Small inaccuracies in the casting and finishing of pier tops and beam bases often resulted in "daylight" appearing under parts of the bearing areas. Numerous expedients, including tapered metal shims and fabric pads of variable thickness, were used to overcome this difficulty. Then it was discovered that the application of a slight twist to the unloaded beam was usually all that was needed to insure a perfect bearing. After the end diaphragm is cast, the beam ends are locked in position with full bearing on the supporting shoe or pad.

Originally it was planned to limit the use of precast beams to skews of not more than 30 deg. This limitation has since been modified and we now use them on any skew that can be accommodated by any other type of beam. Actually they have been used for skews up to about 65 deg. Initially we thought that for standardized production with steel forms minor variations in length would be troublesome. This has not proved to be a difficulty. Such beams can be built economically and are regularly used in curved, flared or trapezoidal spans where every beam length is different.

In the design of the beams the variables are lateral spacing and prestress reinforcing. All design is based on materials with ultimate strengths of 5,000 psi for concrete and 250,000 psi for strand. Economy dictates the utilization of the full potential strength of the beam where possible, and most designs are based on the use of the minimum number of beams necessary to satisfy the requirements of length and loading. For short structures, particularly grade separations with three or

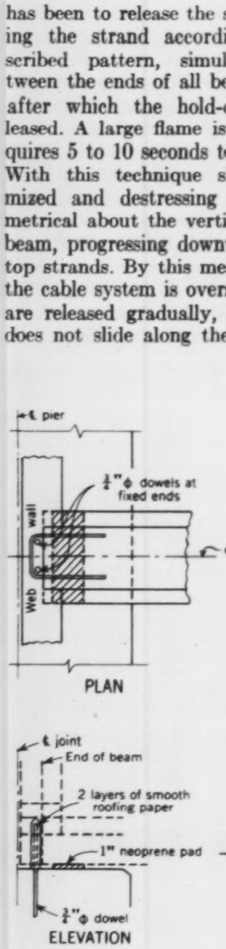

℄ pier
½"φ dowels at fixed ends
Web wall
℄ beam
PLAN
℄ joint
End of beam
2 layers of smooth roofing paper
1" neoprene pad
½"φ dowel
ELEVATION

FIG. 3 (far left). Bearing details for beams on neoprene pads show simple dowels in the cast-in-place diaphragm at fixed ends. This method is satisfactory in most cases and is economical.

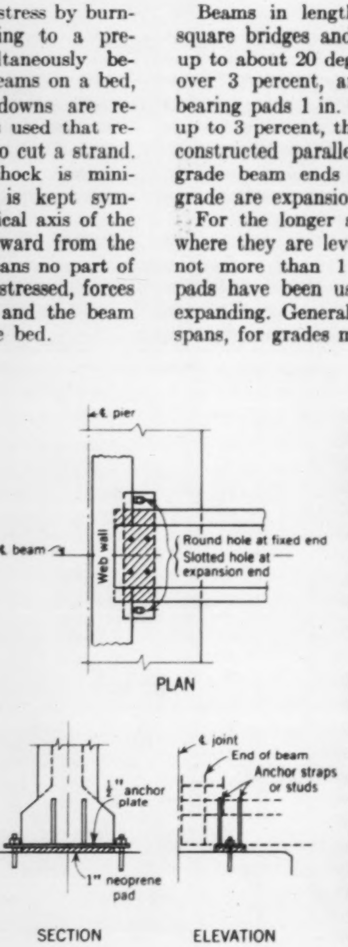

℄ pier
Web wall
Round hole at fixed end
Slotted hole at expansion end
PLAN
½" anchor plate
1" neoprene pad
SECTION
℄ joint
End of beam
Anchor straps or studs
ELEVATION

FIG. 4 (near left). Bearings with anchor plates, while more costly, are still preferred for superelevated spans, skews, and heavy grades where longitudinal guidance and lateral restraint are needed at both ends.

four spans, the same depth of beam is generally used throughout. In some instances, for short end spans, the outer beams are constructed as full-depth fascias and the interior beams have a smaller section. For longer structures beam sizes may be varied for maximum economy in the various span lengths.

Varying the length of beams of the same size of course requires the use of variable reinforcing details. Typical reinforcing details for beams of Types II, III, and IV in approximately maximum lengths are shown in Fig. 5. For shorter beams or for those requiring less reinforcing, the reduction is made by eliminating cables from these groups while holding to the same general arrangement, thus permitting the use of the same stressing headers on the production beds. Reductions are generally made in modules of four cables.

One point of which our designers have to be frequently reminded is that these beams are produced on beds from 400 to 600 ft long so that it is impracticable to make only one or two with a particular strand pattern. This is also the reason why cables in particular beams are frequently varied during manufacture. To make a full run of beams on a bed the producer is permitted to increase the number of strands as long as he does not overstress the beam. Frequently the beam requirements for one project have been completed except for one or two beams. These may be included with another project employing a greater number of strands if desired.

These beams are being placed at a substantially lower price than are beams of any other type capable of rendering the same structural service. Together with prestressed bearing piles, sheetpiles, and bridge slabs they have been the basis for the establishment of a considerable Florida industry which has made us largely independent of out-of-state materials and manufacturers.

In 1954 and 1955, when we were in the process of adopting standardized prestressed practice, a number of jobs were advertised on the basis of competitive designs using both steel I-beams and reinforced concrete T-beams as alternates at the contractor's option. This troublesome and time consuming practice was abandoned after the prestressed members had been consistently bid low on about forty jobs. With the abandonment of alternate designs we watched for an increase in the price of prestressed parts but in our experience this has not occurred. In fact, increased competition has held the price of prestressed parts at the same level or below that of some four years ago. Depending on quantity, job location, and reinforcing details, the price of Type II beams is generally from $12 to $16 per lin ft in place. For Type III beams, the prices per lineal foot are from $14 to $18 and for Type IV from $22 to $28. During the year 1959, total quantities and average unit prices of the three beams let to contract were:

Type II	113,262 lin ft	$13.34 per ft
Type III	144,588 lin ft	$16.01 per ft
Type IV	25,165 lin ft	$23.74 per ft

The above are total prices for the beams, furnished and erected.

Deflection of these prestressed beams presented a problem which required the coordination of design practice and observed field behavior. We are not particularly concerned with the initial camber of the bare beam as this can always be compensated for by haunching or insetting the bottom of the slab. During pouring of the slab, allowance must be made, in setting the grade of the bottom slab form and that of the longitudinal screed guides, for the immediate deflection of the beam under the slab load and the subsequent plastic deflection of the composite beam-slab section.

To arrive at the deflections, values for the modulus of elasticity for instantaneous and plastic deflections must be determined. The commonly accepted formula,

$$E = 1{,}800{,}000 + 500\,f'c$$

would give the value of 4,300,000 psi for the instantaneous E value of 5,000-psi concrete. The value of E for plastic deflections is commonly taken as 0.4 of the instantaneous E.

We made numerous strain measurements on concrete cylinders under compression using various mixes and combinations of aggregates common in our practice. Taking E as the secant modulus from 500 psi to 2,000 psi, which is an average stress range for prestressed beams, we determined its value for the 5,000-psi mixes, when fully cured, at about 4,000,000 psi. This value was used for computing the instantaneous deflection of the bare beam and 1,600,000 psi for the plastic deflection of the composite section.

Field observation soon made it evident that computed deflections were considerably in excess of the actual ones. Using measured deflections from several jobs and varied beam spans, we arrived at 6,000,000 psi as an average value of E for instantaneous deflection. We use 2,500,000 psi as the value for computing plastic deflection of the composite section. With these values we have been able to predict deflections from slab load quite accurately, and the average net effect of allowing for the plastic deflections has been to finish the slab surface to a slight camber of about 1/16 in. per 10 ft of span.

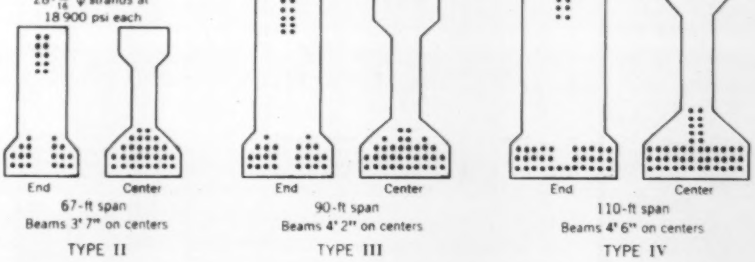
Conclusions

During the spring of 1959, the Freyssinet Company of New York conducted a survey to determine the extent to which the standard AASHO-PCI precast I-sections were being used in the various states. The results were published in the September 1959 issue of the Journal of the Prestressed Concrete Institute. Briefly summarized, this survey showed:

37 states use precast, prestressed I-sections.
27 states use AASHO-PCI sections.
9 states use state standards.
1 state uses BPR sections.

Considering that this survey was made only two years after issuance of the AASHO-PCI standards for sections, the results indicate a rather strong endorsement. This wide use of the standards should have the effect of stabilizing both prices and practices throughout the country, to the general benefit of the prestressed concrete industry and its clients.

FIG. 5. Typical reinforcing details are shown for beams of maximum lengths.



Flexible barge dock on a fluctuating river

F. EARL HOGAN, F. ASCE, Chief, Structural Design Section, Louisiana Department of Public Works, Baton Rouge, La.

LOUIS J. CAPOZZOLI, Jr., A.M. ASCE, Chief Engineer, ETCO Engineers and Associates, Baton Rouge, La.

Structural design, soil mechanics and field work each had interesting aspects in the construction of a barge dock on the Atchafalaya River at Krotz Springs, La. The river is 90 ft deep and a quarter of a mile wide at the site. Its surface ranges from a high stage of El. 38.5, with a velocity at 11.5 fps, to a low stage of El. 2.0, with a velocity of 3 fps. The banks are of loose silty alluvial material. A levee at El. 40 limits the approach to the site.

River traffic on the Atchafalaya at Krotz Springs increased from a half million tons in 1955 to nearly five million tons in 1958. This was due largely to dredging on the downstream reach, which provides access to the Intracoastal Waterway and to the Gulf on a route that is 70 miles shorter than the route to the mouth of the Mississippi. To the north, the Atchafalaya, through Old River, connects with the Mississippi River near the Mississippi-Louisiana line.

The barge dock was built to handle items of commerce for the area regardless of river stage. Engineering was done by the Louisiana State Department of Public Works at the request of the Greater Krotz Springs Port Commission.

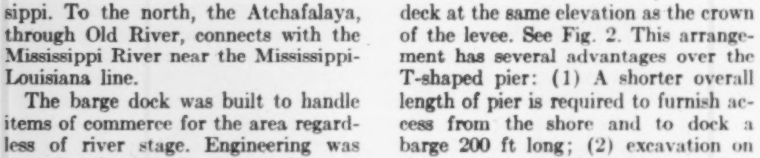
Design considerations

Three arrangements for the barge dock were given consideration. The first, shown in Fig. 1(*a*), would involve the use of an earthen ramp and a floating wharf. A ramp about 700 ft long with a 5-percent grade would have been required to furnish access to the wharf at all stages of the river. The wharf would be equipped with a bridge to provide for the passage of trucks to and from the ramp. Unloading equipment would be stationed on the wharf and the barge to be unloaded would be tied alongside. This plan was discarded because of the problems of maintaining the ramp, especially in the event of a sloughing bank, and the difficulties of moving the wharf, without the use of a tug, from one location to another with changes in river stage.

Two types of fixed docks were investigated, one parallel to the channel of the river, Fig. 1(*b*), and the other perpendicular to it. A dock perpendicular to the stream, in a slip excavated into the bank was chosen, with the deck at the same elevation as the crown of the levee. See Fig. 2. This arrangement has several advantages over the T-shaped pier: (1) A shorter overall length of pier is required to furnish access from the shore and to dock a barge 200 ft long; (2) excavation on the opposite side of the pier can double the berthing capacity when necessary; and (3) the excavated slip provides a still-water docking area, free from drift and unaffected by possible sloughing of the river bank. Excavated material was used as embankment to raise the elevation of the surrounding batture and to provide a roadway to the levee.

The slip was excavated to El. 1-6, to provide for the docking of a barge 50 ft wide by 200 ft long. A pier 26 ft wide and 308 ft long, supported on pipe-pile bents spaced 20 ft on centers, met the requirements. The deck was designed to support the tipping load of a dragline weighing 50 tons and carrying a 35-ton load.

FIG. 1. Proposals studied and discarded included: (a) a floating wharf to be moved along a paved ramp, and (b) a T-shaped dock.



The fender system posed a most difficult problem. To provide one that would absorb the kinetic energy of a barge docking anywhere from El. 3.0 to El. 38.5, without applying any horizontal load to the slender pier, was found to be impracticable.

Flexible pier

A flexible pier, supporting its own fendering system and capable of absorbing the kinetic energy by means of its own deformation, appeared to be the solution. The design assumed a horizontal point load obtained from 0.4 of the kinetic energy exerted by a displacement of 50 x 200 x 9 ft, striking the pier at a perpendicular speed of 0.75 fps and deflecting the structure a maximum of 6 in. at the deck. The remaining kinetic energy was assumed to be dissipated in the glancing blow of the barge, in impact losses, and in the elastic deformation of the barge hull.

Investigation showed that 14 BP 102 piling was more economical than pipe piling in providing for the axial loads as well as the stresses due to bending. The conditions assumed as design criteria are based on unusual approaches under adverse conditions and justify an increase in the allowable stresses of the structural system. The AISC allowable stresses were increased by 50 percent and then decreased by 10 percent to allow for loss of metal by corrosion. This resulted, for example, in an allowable bending stress of 27,000 psi for the extreme fibers of the member. This high stress is advantageous from the standpoint of energy absorption, which varies as the square of the fiber stress due to bending.

The plan and elevation of the deflected structure are shown in Fig. 2.

Forms for cap and deck were supported from the piles. The horizontal truss is at El. 13.25. Vertical fender members will be supported by the truss and the deck.

The point of fixity of the piling was assumed to be 12 ft below the mud line. A heavy pile cap 2 ft wide and 3 ft deep fixes the top of the piling against rotation. The formula for energy of impact of the barge is:

$$\text{K.E.}_B = \frac{0.4\ M_B V^2}{2g}$$

See Fig. 2. Substituting in this the criteria given above, the pier must absorb an impact load equal to

$$\frac{0.4\ (5{,}620\ \text{kips})\ (0.75)^2}{64.4} = 19.7\ \text{ft-kips}$$

This is the energy that must be absorbed by the dock

$$(\text{K.E.}_D = \frac{P_T\ \Delta_M}{2}).$$

If the 21-in.-thick concrete deck of the pier is considered to be a continuous beam on an elastic foundation, the pier can absorb an impact load of 23.5 kips with a 6-in. deformation when the load is applied to the deck at the end bent. The pier can absorb a load of 92 ft-kips with a similar deformation if the load is applied to the deck at the center of the structure. This would indicate that the size of the H-piles could have been reduced in the central and shoreward sections of the dock. However, the same piles were used throughout to make it possible to extend the shoreward end if the river channel should change. Since dolphins protect the outboard end of the structure, it is not probable that it will ever receive the design blow.

A horizontal truss is placed at El. 13.25, designed to distribute the impact loads of barges docking at the lower river stages. This truss, working as a continuous beam on an elastic foundation, can absorb impact loads at lower elevations of magnitudes similar to those absorbed at the deck level. The deflection at deck level is estimated at about 6 in.

Fender system

The fender system (Fig. 3) consists of vertical members on 10-ft centers supported by the deck of the pier and the horizontal truss at El. 13.25. These vertical members cantilever down to El. 4.5 to provide for docking at low river stages. The chord of the horizontal truss, plus two intermediate horizontal members, make up the grid fendering system. Complete continuity was obtained by welding the entire grid. Rubbing timbers are provided on the exposed face of the grid system.

In the design of the fenders, the horizontal load was taken as spread over an area 30 ft long and 10 ft high rather than applied at a point, as in the design of the bents of the pier. The design of the grid recognized continuity in each direction as well as the yielding of the supports with some simplifying assumptions. This resulted in the use of 24 WF 130 for vertical members, 10 WF 60 for the chords of the horizontal truss, and 10 WF 49 for the intermediate horizontal members.

Piles were painted before driving with a coal tar epoxy paint to an elevation 4 ft below the mud line. Other steel members were painted with the same material after construction. Dolphins, at the river end of the pier, have twelve timber piles each, tied at the top and blocked and tied at two lower elevations. It is expected that barges will pivot on these dolphins as they approach the pier.

Soil conditions

Soil exploration was necessary to determine the embedment of the piles required to support a 100-ton load and to determine the most economical side slopes for the excavated slip. The profile of stratification through borings at each end of the dock is shown in Fig. 4. The upper 20 ft of soil consists of typical recent river deposits made up of loose sands, sandy silts, and clayey

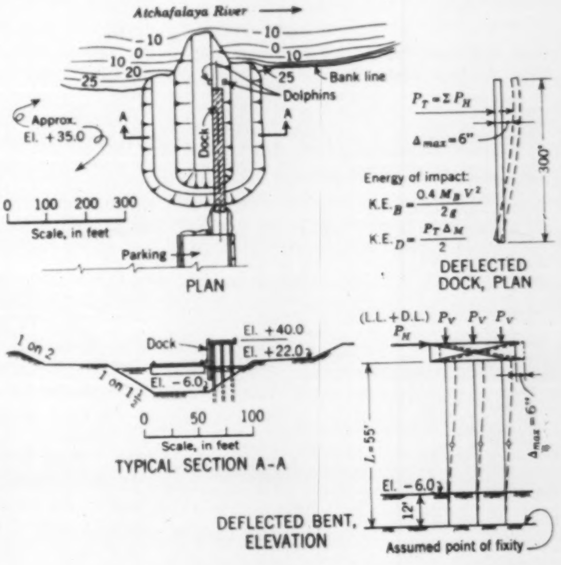
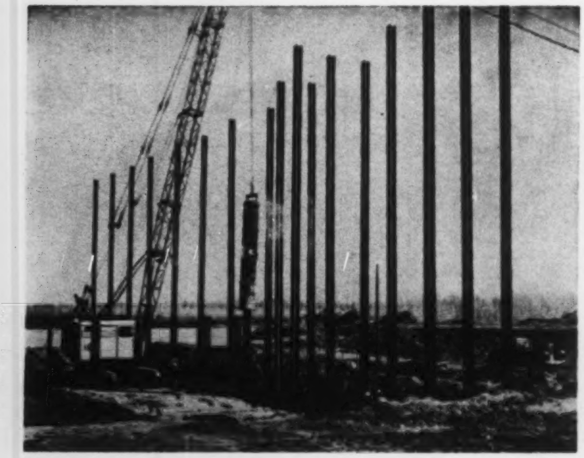

Atchafalaya River
-10
0
10
20
25
-10
0
10
25
Bank line
Dolphins
Approx. El. +35.0
A
A
Dock
0 100 200 300
Scale, in feet
Parking
PLAN
$P_T = \Sigma P_H$
$\Delta_{max} = 6''$
300'
Energy of impact:
$\text{K.E.}_B = \frac{0.4 M_B V^2}{2g}$
$\text{K.E.}_D = \frac{P_T \Delta_M}{2}$
DEFLECTED DOCK, PLAN
1 on 2
Dock
El. +40.0
El. +22.0
1 on $1\frac{1}{2}$
El. -6.0
0 50 100
Scale, in feet
TYPICAL SECTION A-A
(L.L.+D.L.) P_V P_V P_V
P_H
$L = 55'$
$\Delta_{max} = 6''$
El. -6.0
12'
DEFLECTED BENT, ELEVATION
Assumed point of fixity

FIG. 2. Plan and details of Krotz Springs Barge Dock.



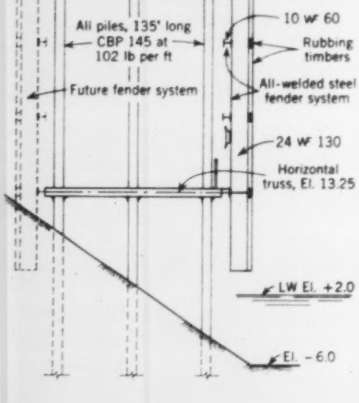
Piles are being driven with a diesel hammer. Note length of hammer and absence of air or steam hoses.

Completed dock is seen with water at El. 23. Deck is at El. 40. about the level of the levee in this area.

silts, plus soft silty clays underlain by a clay stratum.

The uppermost stratum of soft silty clay had an average cohesion of 350 psf, a moisture content of 31 percent, and a dry density of 78 pcf. The stiff clay and silty clay had a cohesion of 1,000 psf, a moisture content of 30 percent, and a dry density of 92 pcf. The medium clay underlying the upper stiff clay stratum had an average cohesion of 600 psf, a moisture content of 40 percent, and a dry density of 78 pcf. The liquid limits of these clay strata varied from 67 to 96, the plastic limits from 22 to 37. The results of consolidated undrained triaxial compression tests on the medium dense sandy silt indicated an angle of friction of 38 deg and a cohesion of 250 psf. The number of blows per foot of penetration of a standard 2-in. split-spoon sampler driven into the lower dense sand stratum varied from 46 to an excess of 150.

FIG. 3. Support and fender system for Krotz Springs Barge Dock.



Pile design

Selection of the pile type was governed by the superstructure, which required a 14 BP 102 section. The possibility of using pipe piles of the closed-end displacement type was investigated thoroughly since such piles would fetch up more rapidly in the underlying sand stratum; however, the bending moments produced by the barge impact were more economically resisted by H-piles. The load-carrying capacity required in the piles was 100 tons each. Skin friction on the piles from the stiff clay at boring No. 1 provided a carrying capacity of only 45 tons each and it was necessary for the piles to penetrate the underlying sand stratum. This made the piles essentially point bearing and it was decided to obtain all their carrying capacity from the dense sand.

Piles were required to be driven so that their tips would be at El. −97, or to a bearing capacity of 100 tons as determined by the *Engineering News* formula, using a hammer with a minimum ram weight of 8,000 lb. With the pile tip at El. −97 an embedment of 20 ft was provided in the sand, and a pile 135 ft long, weighing almost 7 tons, was required. This was driven in a 60-ft and 75-ft section with a welded splice connecting the two.

An assumed friction angle of 40 deg in the sand enabled the pile to obtain the necessary capacity from skin friction. Use of a thickened point on the pile was investigated but discarded since it was more economical to use an added length of pile. Use of a bearing plate on the pile was also discarded since it would not have allowed sufficient penetration to transfer the pile load to the sand. Actually, the contractor drove the piles to El. −97 even though the 100-ton capacity was usually obtained at an elevation several feet higher. This eliminated any necessity for pile cutoffs, which would have been paid for by the owner.

A Delmag D-22 diesel pile hammer was used for the driving. The diesel hammer requires no long steam or air lines, is light in weight, has few moving parts, and uses a relatively small amount of fuel compared to a steam or air hammer. Its disadvantage was the lack of an accurate method of determining the energy per blow.

In operation, the diesel hammer has a ram that falls inside a cylinder closed at the bottom and strikes an anvil block holding a few drops of fuel. In striking the anvil block the ram atomizes the fuel, which is ignited by the heat of compression, forcing the ram upward and the pile downward. As the ram reaches the top of its travel, where it is usually stopped only by gravity, the spent fuel is exhausted, and a new charge added. The ram again drops and the cycle is repeated. The operation is continued as long as fuel is supplied to the hammer or the ram bounces high enough to obtain enough potential energy to ignite the fuel on the downward stroke.

Since no uniformity on the energy rating of diesel pile hammers has been achieved, it was conservatively decided to rate this hammer solely on the height of fall of the ram. This varied between 6 and 6.5 ft during the pile-driving operations. The pile capacities as determined by the *Engineering News* formula, using the actual fall of the hammer, varied from 105 tons to 150 tons with the exception of two piles, one of which was 93 tons, the other 170 tons. These two latter figures corresponded to an ultimate penetration resistance of 4 blows per inch and 12 blows per inch. The general average was 6 to 8 blows per inch.

Stability of excavated slip

Soil conditions encountered at the site, plus the desirability of keeping the excavated material to a minimum, made necessary a careful analysis to determine the stability of the ground around the area excavated. The ground surface is at El. 35, minimum water level at about El. 3, and the mud line was assumed to be at El. −8, providing 2 ft of overdredging. The sliding-circle method of stability analysis was used (Fig. 5). A design was sought that would provide a factor of safety of 1 under an instantaneous drawdown condition from El. 35 to El. 3.

Laboratory tests showed the angle of friction in the medium dense sandy silt to be 38 deg; it was reasoned that any sliding circles would be tangent to this stratum. An analysis performed using a conventional 1 on 2 slope indicated a factor of safety of 0.87. Flattening the slope to 1 on 3 increased the factor to 0.92. The flatness required to produce a factor of safety of 1.00 in this manner would have resulted in an uneconomical amount of excavation. A berm would have the effect of restraining the toe of the 1 on 3 slope and removing some additional material at the top of the slope. The minimum factor of safety for the section shown in Fig. 5 is 1.03. The minimum factor of safety for the toe of the berm is 1.20.

The accuracy of the assumptions made for the stability analysis was inadvertently checked in the field. Almost the entire slope consists of clay. The stability of a slope on clay is dependent primarily on the height of the slope and the strength of the clay rather than on the flatness of the slope. The toe as designed had the berm at El. 22, the water at El. 3 and the mud line a El. −8, giving 19 ft of saturated soil and 11 ft of submerged soil. Since the weight of the submerged soil was approximately half that of the saturated soil, the effective height of the slope could be said to be 24.5 ft. Using Taylor's stability numbers, a required cohesion for stability of 500 psf was obtained. The available cohesion in the medium clay below El. 5, which consists of practically the entire slope, was 600 psf and provided a factor of safety of 1.2.

The construction procedure resulted in a berm at El. 25. Inasmuch as the excavated material was to be used as embankment fill, most of it was excavated in the dry to El. −6 before cutting through to the river. The resultant slope, 31 ft high, required a cohesion of 630 psf, which resulted in a factor of safety of 0.95. Most of the slip below the berm was excavated in two days. This amounted to essentially an instantaneous drawdown, with the net result that the toe of the berm failed. The question may be asked as to why the failure occurred in the toe of the berm, which had a factor of safety of 1.2, rather than in the entire slope, which had a factor of safety of 1.03. By excavating only to El. −6 without any water in the slip, the weight on the toe was reduced by the difference between 9 ft of water and 2 ft of soil. This was a small quantity compared to the weight of the entire slope and amounted to a change of less than 0.01 in the factor of safety.

To arrest the slide, two remedial steps were taken. The first was to admit water into the slip to weight the toe. The second was to cut the berm down to El. 17. Both measures were required since the clay had been remolded during the slide and its strength reduced.

The dock was designed in the offices of the State Department of Public Works under the direction of Mr. Hogan as Chief of the Structural Design Section, and under the supervision of Hu B. Myers, F. ASCE, Chief Engineer. The structural analysis of the dock was performed by Wayne Sexton, A.M. ASCE, Design Engineer. The soil analyses and foundation recommendations were made by ETCO Engineers and Associates under the direction of Dr. Capozzoli. The dock was built by Gurtler, Hebert and Company, Inc., of New Orleans, La., at a cost of $228,011.

(The paper on which this article is based was presented by Messrs. Hogan and Capozzoli at the ASCE New Orleans Convention, at the Soil Mechanics and Foundations Division session presided over by Stanley J. Johnson, a member of the Division's Executive Committee.)

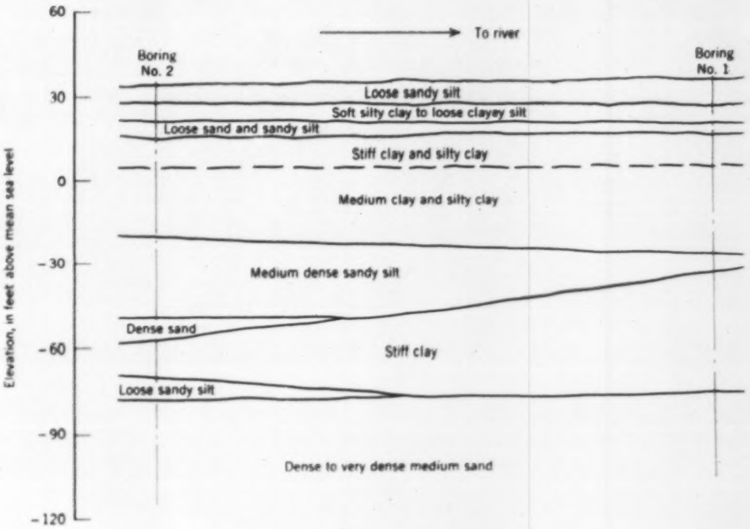
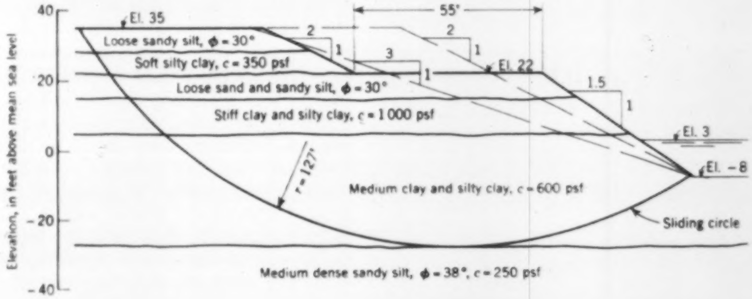
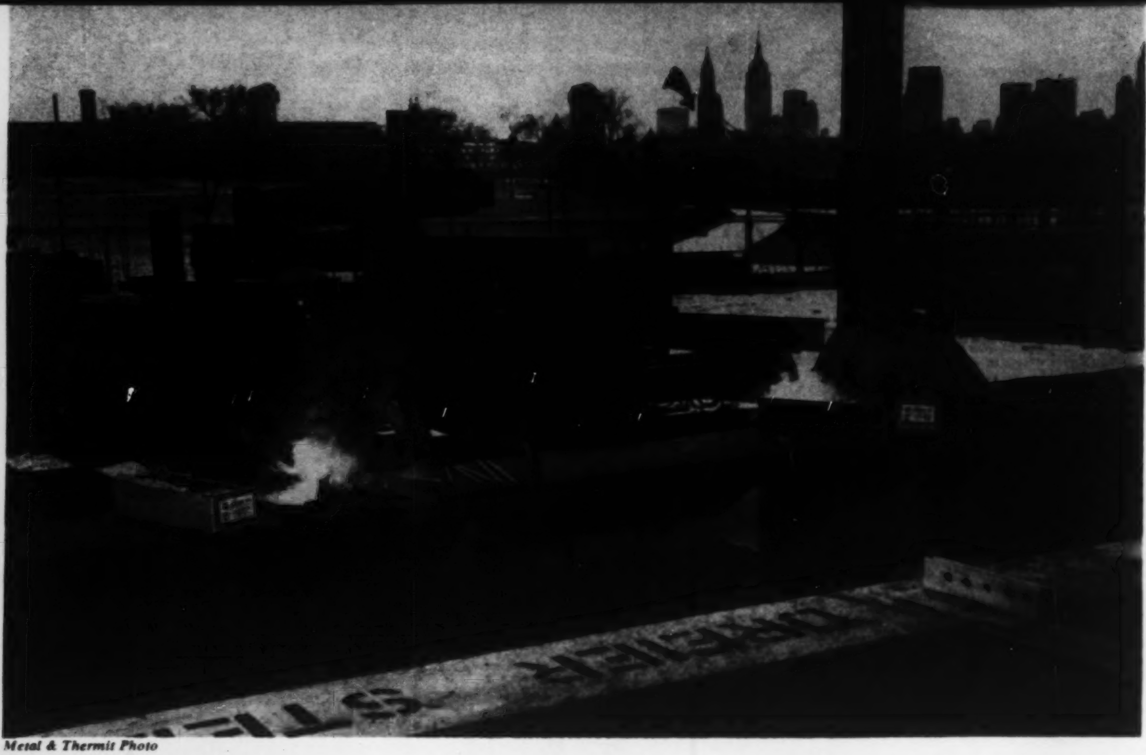

60
30
0
-30
-60
-90
-120
Elevation, in feet above mean sea level
To river
Boring No. 2
Boring No. 1
Loose sandy silt
Soft silty clay to loose clayey silt
Loose sand and sandy silt
Stiff clay and silty clay
Medium clay and silty clay
Medium dense sandy silt
Dense sand
Stiff clay
Loose sandy silt
Dense to very dense medium sand

FIG. 4. Soil profile from two borings.

FIG. 5. Soil strengths used in the stability analysis and final design are shown. The radius of the sliding circle is 127 ft.


40
20
0
-20
-40
Elevation, in feet above mean sea level
El. 35
55'
2
1
3
1
2
1
El. 22
1.5
1
El. 3
El. -8
Loose sandy silt, ϕ = 30°
Soft silty clay, c = 350 psf
Loose sand and sandy silt, ϕ = 30°
Stiff clay and silty clay, c = 1000 psf
r = 127'
Medium clay and silty clay, c = 600 psf
Sliding circle
Medium dense sandy silt, ϕ = 38°, c = 250 psf



Metal & Thermit Photo

Heavy steel for United Engineering Center is fabricated across East River from the building site, shown by arrow. At left of arrow is the United Nations Building, at right are the Chrysler and Empire State buildings and other mid-Manhattan structures.

United Engineering Center

1. An all-welded structure

SAMUEL C. BAST, F. ASCE, Associate, Seelye, Stevenson, Value & Knecht, New York, N. Y.

The United Engineering Center, now rising rapidly on United nations Plaza in New York, is an all-welded structure with some unusual features. To a height of three stories the building covers the block on United Nations Plaza between 47th and 48th Streets. It extends 147 ft along 47th Street and 222 ft along 48th Street. Above this three-story base structure a tower section 139 x 66 ft rises to a height of 18 stories with an additional two floors for mechanical equipment. The tower, which has a height of 283 ft above 47th Street, has exterior walls of glass, stainless steel and limestone in keeping with the modern trend.

Eighteen or more national engineering societies will occupy the tower section of the structure when it is completed next summer. The new structure will give each of the groups more space and a better arrangement for their activities than is possible in the present structure. ASCE will use the two top floors, as it does in the present building. Two floors of the tower are not yet assigned. Further room for expansion is provided by plans for a second tower with 8,500 sq ft of space per floor from the third to the eighth floors and 6,000 sq ft from the ninth through the twelfth.

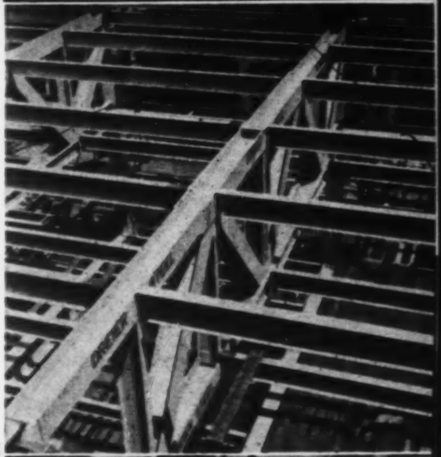
The main entrance to the new building is on 47th Street. The lobby will be finished with marble walls and terrazzo floor. On the first floor there is an Exhibition Hall just off the lobby with a display area of 6,235 sq ft. On the 48th Street side there will be dining rooms, meeting rooms for up to 400 people, and the first level of a five-tier stack library. The library will have a capacity of 225,000 volumes, and a reading room on the second floor. The general offices of the United Engineering Trustees, Inc., Engineers Joint Council and the Engineers Council for Professional Development are on the third floor.

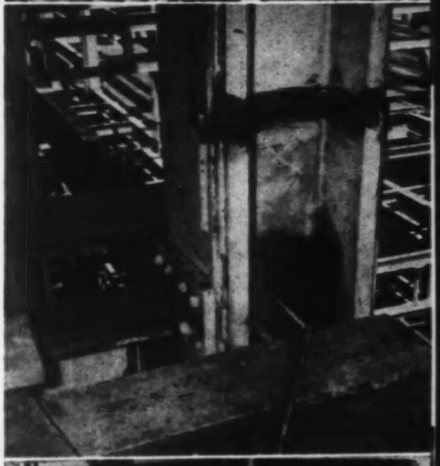
Structural considerations

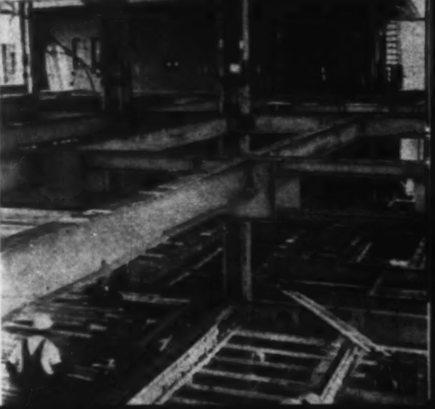
The foundations are on Manhattan schist and the footings, with a few exceptions, are designed for 20 tons per sq ft. During excavation the rock was found to be decomposed in some areas and it was necessary to redesign some of the footings for a capacity of 8 tons.

In general the superstructure is a steel frame with gritcrete (lightweight aggregate) floor slabs. The basement and first-floor slabs are of conventional stone aggregate concrete.

To save space and provide the most







1. Steel rises for the United Engineering Center. In background can be seen the United Nations Secretariat and Assembly Building.
2. Heavy 50-ft truss over a meeting room will eventually carry a 919-kip load for a planned expansion of the building.
3. Cover-plated column has a plate riveted on for wind-bracing connection.
4. Air-conditioning ducts are taken through the webs of girders. Note reinforcement around the openings.

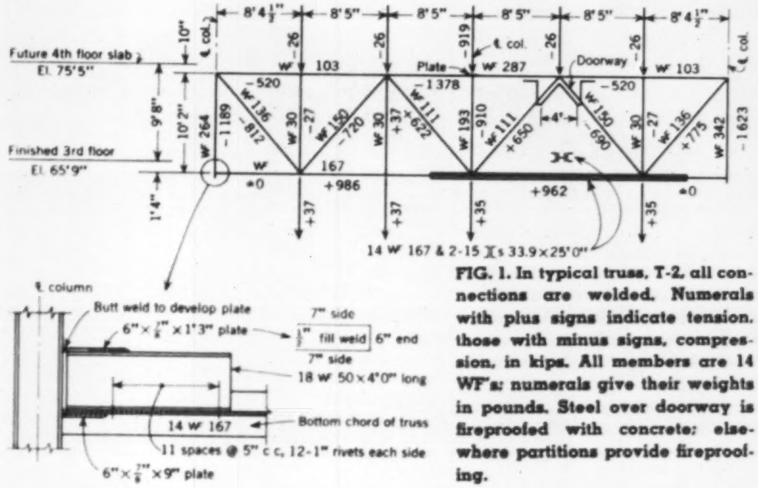

8'4½"
8'5"
8'5"
8'5"
8'5"
8'4½"
10"
℄ col.
-26
-26
-919
℄ col.
-26
-26
℄ col.
Future 4th floor slab
El. 75'5"
W 103
Plate
W 287
Doorway
W 103
-520
-1378
-520
9'8"
10'2"
W 264
-1189
W 136
-812
W 30
-27
W 150
-720
W 30
+37
W 111
+622
W 193
-910
W 111
+650
4'
W 150
-690
W 30
-27
W 136
+775
W 342
-1623
Finished 3rd floor
El. 65'9"
W 167
±0
+986
+962
±0
1'4"
+37
+37
+35
+35
14 W 167 & 2-15 ⌶s 33.9×25'0"
℄ column
Butt weld to develop plate
6"×⅞"×1'3" plate
7" side
½" fill weld
6" end
7" side
18 W 50×4'0" long
14 W 167
Bottom chord of truss
11 spaces @ 5" c c, 12-1" rivets each side
6"×⅞"×9" plate

FIG. 1. In typical truss, T-2, all connections are welded. Numerals with plus signs indicate tension, those with minus signs, compression, in kips. All members are 14 WF's; numerals give their weights in pounds. Steel over doorway is fireproofed with concrete; elsewhere partitions provide fireproofing.

attractive office space, the tower section was framed with only one row of interior columns. For best exterior appearance and greatest window space, the wall columns were limited in width. On the east side the structure is cantilevered out 11 ft beyond the column line. This area is being used for especially attractive executive offices overlooking the United Nations Plaza. The arrangement permits a most effective facade and more freedom in interior arrangement. It made necessary the use of many coverplated columns, the heaviest being in the cantilever area, where a 14 WF 426 with 3⅜ x 14-in. plates on each side is used.

Welding affords savings

In the interest of economy a study was made of the three possible methods of field connection—rivets, high-strength bolts, and welding. Welding was found to give a compact design for wind bracing. This design satisfied the space limitations and developed a rigid frame that made possible the use of one-twelfth ($1/_{12}$) as the positive-moment factor for the girders. All these design ideas, added together, yielded a substantial saving.

Some difficulty was encountered with the wind connections to the columns with thin cover plates. If welding was done through the plates to develop resistance to the wind moment, the detailer felt the welds would become too thick to be practical. After several solutions had been discarded, a thick plate riveted to the column was selected. Rivets as large as 1⅛ in. in diameter by 7 in. long were installed in the shop through a 3-in. flange and a heavy plate—thick enough to transfer the moment from the beam to the column section.

The fill-in beams and secondary beams framing to the girders are designed as simple spans under live and dead loads. Field connections are made by ordinary bolts.

There are three trusses over the main meeting room. These trusses, 50 ft long, support the present third floor and roof. Future expansion plans include building over this area to the twelfth floor. These trusses, 10 ft 2 in. deep, are made up of welded 14-in. WF sections (Fig. 1). The two end members of the trusses will be an integral part of the columns in the future. The trusses are designed to pick up a column load of 919 kips at the center for the added structure.

Four arc-welded girders over the library stacks support the roof. Part of this area will in the future be extended to the eighth floor.

Air conditioning

Air conditioning, with zoned control, will operate throughout the building. The water-chilling plant is on the

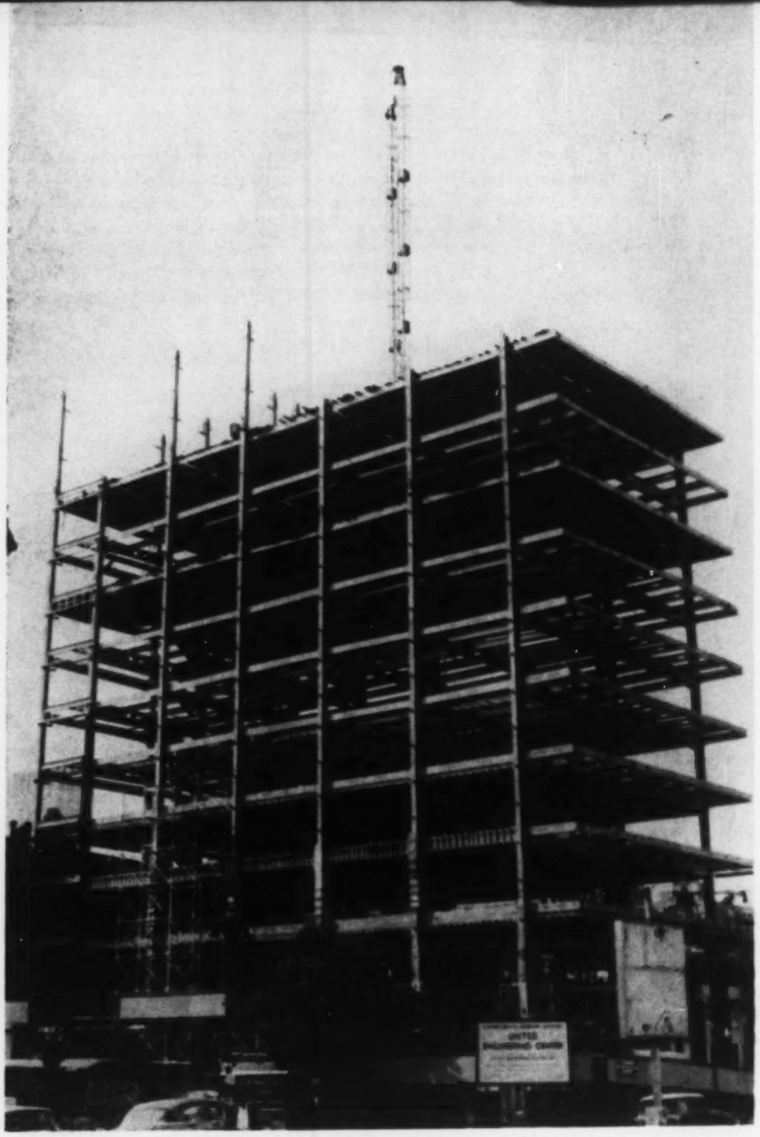
the surface would raise the water level equipment is at ground level. Steam is used to heat the building and furnish energy for the operation of the water-chilling machines. One centrifugal and one absorption unit are arranged to utilize steam twice—first to drive the turbine compressor of the centrifugal machine, and then to supply the heat energy necessary for the operation of the absorption machine. A refrigerating capacity of 880 tons is provided to condition 228,000 cu ft of air per min. To maintain the economical story height, the ducts and pipes are threaded through the girders. Many of the girder webs required reinforcing.

Lighting and elevators

Office lighting will be fluorescent, operated at 265 volts, placed modularly to provide an average of 75 footcandles in open areas. Incandescent lighting is operated at 120 volts. Four elevators, capable of speeds of 700 fpm, will be installed to meet present requirements. Provision is made for two additional elevators when needed in the future.

This new home for 18 American engineering groups will be owned and operated by the United Engineering Trustees, Inc. It is being financed through contributions from engineers and industry throughout the world.

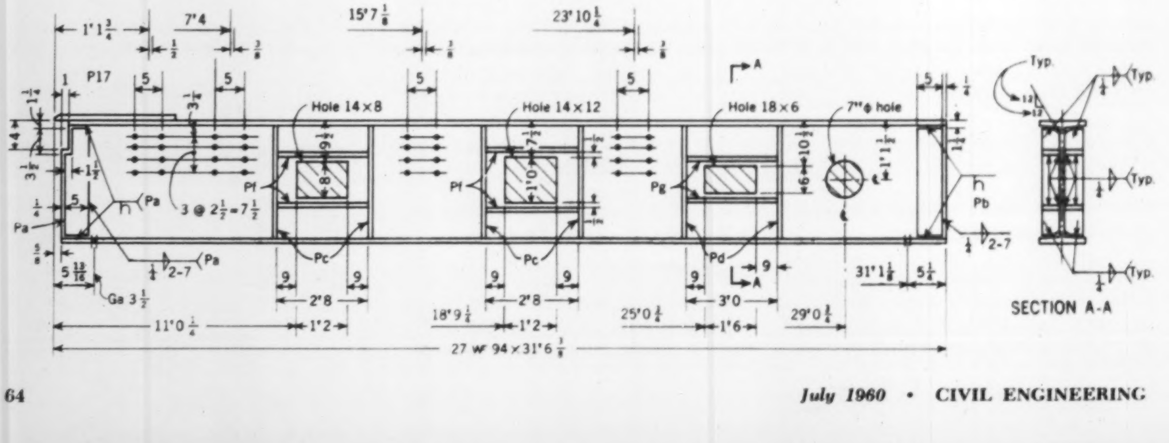
The trustees selected the architectural firm of Shreve, Lamb & Harmon Associates to plan this new home. The firm of Seelye Stevenson Value & Knecht are the structural engineers; Jaros, Baum and Bolles are the mechanical engineers, and the Turner Construction Co. is the general contractor.



Steel was at the 11th floor level with columns set for the 12th and 13th floors when the cornerstone was laid by former President Hoover on June 16.

FIG. 2. Typical shop detail for a beam on the fifth floor. Stiffening around openings is used on both sides of the beam. List of material is given at right.

Mark	No.	Size	Length	Mark	No.	Size	Length
502 (3)	1	27 WF 94	31' 5⅝	P c	8	Pl. 4 x ⅝	2' 1½
P 17	1	Pl. 8½ x 1	2' 0¼	P d	4	Pl. 4 x ½	2' 1½
P a	2	Pl. 5 x ⅝	2' 0⅝	P f	8	Pl. 4 x ⅝	2' 8
P b	1	Pl. 5 x ⅝	2' 0⅝	P g	4	Pl. 4 x ½	3' 0



2. Steel frame for UEC rises rapidly

PHILIP KLEINER, A. M. ASCE, Engineer, Dreier Structural Steel Company, Inc., Long Island City, N. Y.

Steel erection for the United Engineering Center is proceeding at the rate of two floors a week, and steel probably will be topped out in late July. Fabrication and erection of the 3,300 tons of steel are being done by Dreier Structural Steel Company, Inc., of Long Island City, N. Y. All main members are welded but floor beams and similar units are bolted.

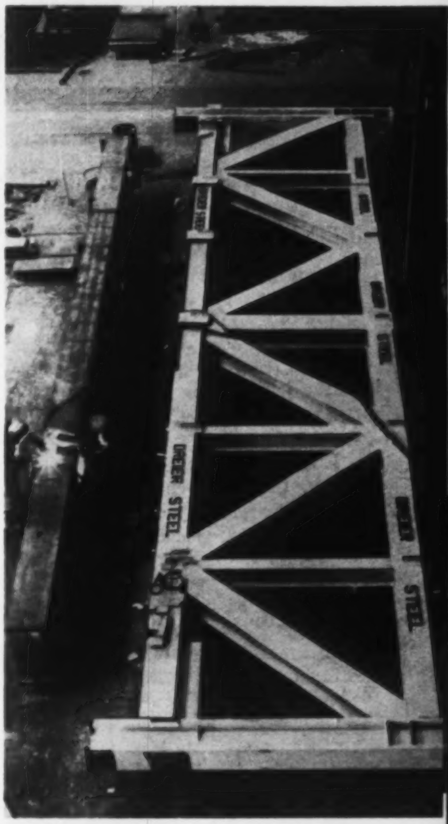
Architectural and economic considerations in the design of the all-welded building created unusual problems for Dreier in the fabrication and erection of the structural steel. The lower three stories of the building cover an area 200 by 147 ft with a 100 x 75-ft "L." These stories accommodate the meeting rooms and library, while the offices to be used by the eighteen national societies are housed in a "tower" 139 by 66 ft, rising to 18 stories above the street.

The steel of the lower portion could not be normal beam framing since large unobstructed areas are required and it is planned to support an additional office tower over it in the future. To satisfy these dual requirements, three trusses and four plate girders were called for. Each truss (Fig. 1, p. 63) has a length of 50 ft, a depth of 10 ft 2 in. and a weight of 22 tons. The girders are 41 ft 6 in. long and weigh 10 to 12 tons each. Welding of the girders and trusses, which are made up of 14 WF sections weighing up to 370 lb per ft, permits a substantial saving in weight. All members are welded directly to each other, eliminating the heavy gusset plates and flange angles required by other methods of connection.

To reduce the story height, a great deal of mechanical and electrical conduit is passed through the steel beams and girders. This required an unusual number of cutouts and extensive reinforcing of the webs. High wind loads, added to the dead and live loads of the building, required exceptionally heavy lower-level column sections; the largest is a 14 WF 426 with two 14-in. by $3\frac{3}{4}$-in. plates, and it weighs 12 tons. To save space in the area of the elevators, box columns, made up of plates $1\frac{1}{2}$ and $1\frac{3}{4}$ in. thick, were utilized rather than the wide-flange sections ordinarily used.

Because of the narrowness of the office part of the building as compared with the lowest three stories, erection was done as two separate operations, using different techniques. The low widespread "wings" and the first floor of the tower section, which contained the heavy girders, trusses and columns, were set with an 85-ton Koehring crawler crane. The crane then placed a guy derrick on the first-floor steel of the tower section, and this derrick was used to set the tower steel.

The 139-ft length of the tower structure, and the necessity of reaching out over the side to pick up steel from trucks on the street, called for a long boom on the erection derrick. But half of the 66-ft tower width offers only a narrow spread for the guy lines. A derrick with a 90-ft boom operating from



Heavy truss, made of 14 WF sections, is designed to span the library and carry future floors above it.

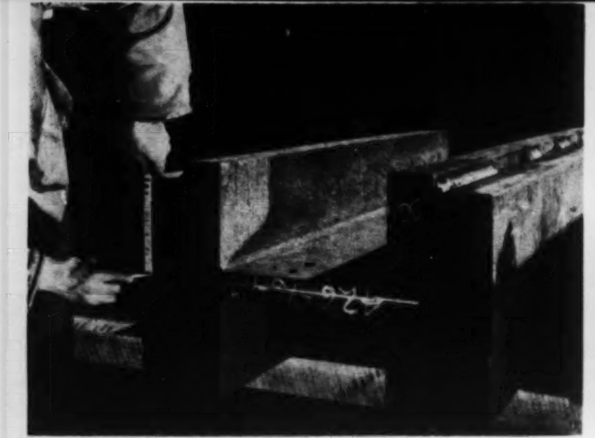
We are close to success; let's finish the fund drive now for the

UNITED ENGINEERING CENTER

Use convenient form on reverse side for your contribution

- **Cut out and mail to** EXECUTIVE SECRETARY WILLIAM H. WISELY
American Society of Civil Engineers
33 West 39th Street, New York 18, N. Y.
- **Headquarters staff will credit your gift to your Local Section.**
- **If you have not pledged, this is your opportunity to help put the campaign over the top.**
- **If you can make an additional pledge, now is the time for that final boost to the UEC drive.**

see p. 42 for data on the UEC drive



One of the columns used in the United Engineering Center. Heaviest is a 14 WF 426 with 3¾ x 14-in. cover plates.

A box column is formed by welding with Lincoln's semi-automatic submerged arc process.

a 100-ft mast was used. The rig can lift 20 tons but the heavy lifts are handled slowly to keep impact to a minimum in the narrow tower. Columns are fabricated in two-story lengths. A shipment to the job comprises the columns for two stories with the girders and beams framing into them.

Erection starts around the periphery, the milled-end columns being held temporarily by bolts through the splice plates. Connecting plates shop-welded to the columns serve as seats for the main beams. The interior floor beams are swung into position and spotted with a pin, then a couple of bolts are placed to hold them.

Six men work in the raising crew, plus a hoist operator and a gang foreman. Two of the men work at the derrick-support level to hook on steel and guide it up to two iron workers who position it and put in a holding bolt or two. One man in the raising crew turns the derrick while the sixth man handles signals to the hoist operator. The raising crew is followed by two men bolting up and three plumbing the structure. The latter is done with turnbuckles on cables tied diagonally to a lower part of the structure. It is necessary that the plumbness of the structure be continually checked as its narrow width, with only three columns in a row, leaves it very limber.

Five welders keep up with the steel erection, working not more than two floors behind the steel at any time, as this keeps the building rigid for erection. Joints are planned for a maximum of down-hand welding. A back-up piece usually is used then a root pass is made, followed by a varying number of passes depending on the depth of the steel. Where the weld has considerable depth and the mass of steel drains away the heat, a low hydrogen rod E-7018 is preferred. For normal welding, E 6013 is used or the relatively new E 6014. The latter has similar characteristics to the E 6013 rod but has iron powder added for faster deposition.

Dreier has found that it pays to produce its own electric power on the job, principally to run the welders. It is less costly to move a compact unit on the site than to bring in electric lines. On the UEC job a big Cummins diesel engine, direct connected to a generator, supplies power to a battery of eight Westinghouse Type RA welders supplying d-c current. The welders are rated at 400 amp. The generator will handle 12 welders, but not all are needed on this job. The generator and the battery of welders will be raised in the structure as steel advances to reduce the length of the welder lead-lines.

The schedule calls for the erection of two floors, or a little more, per week. While the building is called 18 stories high, there is actually a full 19th and a full 20th floor. These house elevator equipment and water towers, which frequently are left exposed and unsightly on the tops of buildings. These areas also house mechanical, air-conditioning and ventilating equipment for the building.

Erection in mid-June is at the eleventh floor. Steel is fabricated for completion of the structure. The traditional topping-out, flag-raising ceremony is scheduled for late July.

Work at the site for the Dreier Structural Steel Co., Inc. is under the direction of Al Holt.

FILL OUT—CUT OUT AND MAIL

A	Subscribed	Paid Herewith	Balance Due

NAME 1960

ADDRESS ....

CITY .... ZONE .... STATE ....

in consideration of the gifts of others intends to give to

UNITED ENGINEERING CENTER BUILDING FUND

.... Dollars $............

Balance will be paid QUARTERLY $............ SEMI-ANNUALLY $.......... ANNUALLY $...........

or as follows..

Gifts are deductable for income tax purposes.

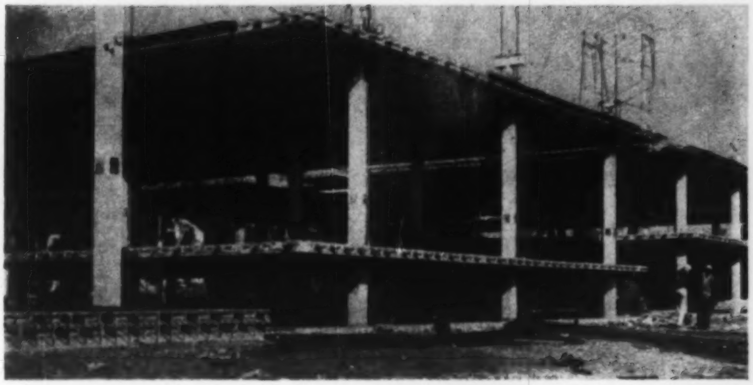
....

Signed

Make checks payable to: United Engineering Trustees, Inc.

Mail to: Exec. Secy. Wisely, ASCE, 33 West 39th St., New York 18, N. Y.

Floor and roof slabs were cast at ground level and then lifted into place. In section of building at left, all the slabs are on the ground; in the center, the roof slab is in place and the second-floor slab is being lifted; at right, roof and second-floor slabs are in place.



Lift-slab construction for U.S.G.S. building

GEORGE D. WHITMORE, F. ASCE, Chief Topographic Engineer, U.S.G.S., Washington, D. C.

A new building constructed by the lift-slab method houses the map preparation facilities of the Topographic Division of the Geological Survey's West Coast Center at Menlo Park, Calif. Located in the San Francisco Bay area, it is part of a concentration of universities and research organizations with all the advantages that these facilities can provide to a professional bureau like the Survey.

Construction

The building, designed and constructed to incorporate many special features, is a two-story concrete structure 340 by 138 ft, with a total floor space of 85,600 sq ft. The floors and roof were put in place by the lift-slab method. In this procedure the two floor slabs and the roof slab were poured at ground level and the second floor and roof slabs were then prestressed, lifted into position, and secured to the reinforced concrete columns. The exterior walls are finished with light brown concrete blocks and the window frames and doors are aluminum.

The interior of the building is arranged so that topographic mapping operations are contiguous, as nearly as possible, to minimize movement of materials and facilitate contacts.

Temperature is controlled by an air-conditioning system in which chilled water from refrigerating machines, or hot water from a boiler, is pumped to fan rooms. Air from the fan rooms, heated or cooled as required, is circulated through the building. A separate central blower system is provided to cool the lamps in the photogrammetric mapping instruments.

Attention to illumination

Because exacting visual work is required in the photogrammetric and cartographic operations, careful attention was given to the design of the lighting and to the electrical supply. All illumination is fluorescent except in the photographic laboratory areas, where incandescent lighting was preferred. Light intensity in different rooms varies from 10 ft-candles (where scribing is done) to 100 ft-candles in areas requiring maximum illumination. In the scribing rooms, special light fixtures provide indirect lighting on the scribing surface. Electricity is supplied to the scribing tables from a ceiling trolley duct. Dimming circuits are provided to vary the intensity of both overhead lights and scribing-table lights.

This building is the third to be completed in the Geological Survey's West Coast Center. Its completion marks another step in the Survey's progress toward an integrated center from which it can carry out its scientific and engineering activities in the Western States.

New building for the Topographic Division of the U. S. Geological Survey in Menlo Park, Calif., marks another step in the Survey's progress toward an integrated center for its activities in the West.

Special fixtures in the scribing rooms provide indirect lighting on the scribing tables from a ceiling trolley duct.

How to negotiate for photogrammetric mapping services

J. S. PILTZ, Engineer of Design
Wisconsin State Highway Department
Madison, Wis.

During the past five years, the Wisconsin State Highway Department has utilized photogrammetric mapping for the location and design of several hundred miles of highway. Application of this modern engineering method has expedited the location of these many miles of new road and improved the quality of the design job significantly. These benefits have been realized in large measure, we believe, because of the procedures through which we have been able to obtain these highly specialized services.

In negotiating for photogrammetric work, we follow much the same philosophy that governs the solicitation of any consulting engineering service. The practice gives us certain very definite controls over mapping quality, a control that design engineers must exercise to realize the fullest advantages of photogrammetry. The procedures outlined here have enabled Wisconsin to obtain top-notch mapping through some 75 separate contracts amounting to more than a million dollars.

The most obvious advantage of negotiation, of course, is the freedom it gives the contracting agency to select an organization qualified and equipped to tackle highly technical assignments. This constitutes our first step toward quality control.

We select a photogrammetric engineering firm on the basis of several very carefully developed criteria. These are:

1. Past performance. It does not take long to discover which organizations are skillful and conscientious. They go to the top of our list of prospective contractors. They have demonstrated that they can follow our specifications and produce for us the detail and accuracy which design work requires.

2. Ability to meet a deadline. The capacity of the photogrammetric engineering profession is considerably in excess of the demand. It is not normally difficult to obtain the services of the firm of our first choice. However, deadlines are so important in this operation that we must determine, early in the negotiations, if a firm is prepared to make delivery on our terms. If they are not, we expect them to say so and give us a chance to approach another organization.

3. Unique requirements of the job. Photogrammetric mapping projects *do* differ. One may require more extensive and complex ground control. Some firms surpass others in this aspect of the job. For such a project, this becomes a major consideration in our choice of a photogrammetrist. On some mapping projects, an unusual amount of cultural detail may be necessary. On others, some "bridging" may be required for one reason or another. So, for a project with some very specialized aspect, we need to know, not only how much equipment a photogrammetric engineering firm has, but what kind.

4. Size is not a major criterion. The highway engineer's photogrammetric requirements are such that a small organization, if it has the proper technical know-how and the basic equipment, can meet established specifications. Some of the department's jobs are small; some are major undertakings. All other things being equal, we have had as good results with small organizations handling small jobs as with large firms doing large ones.

5. Price. The cost of any service must be a factor when public tax money is being spent. Over the years we have been able to estimate rather closely what a mapping job will cost us. If the consultant with whom we choose to negotiate comes back with a price that seems too high, we question him closely. He is sometimes able to prove to our satisfaction that we have overlooked some difficult aspect of the operation or underestimated the time required. He may be able to show us where we can economize without sacrificing quality and we are always willing to reconsider our original demands.

However, we are dedicated to the belief that price as a factor in selecting a photogrammetric engineering firm is properly a matter of third or fourth consequence. We must have accurate maps on which to locate and design our roads. Photogrammetry, as an aid to proper location for example, can save a highway department thousands of dollars in earthmoving and construction costs. Even the most accurate and detailed maps amount to only a tiny fraction of the total cost of a highway. This is a poor place to sacrifice quality.

In brief, these are the criteria on which we base our choice of a photogrammetry firm—its past performance, its ability to meet a completion date, its strength in some specialized aspect, its equipment, and its ability to do the job within our estimate of what it should cost.

How can a department be sure it is receiving the final product it ordered? We suggest two tried and true measures:

First, provide an intelligent set of specifications.

Second, utilize a simple procedure for checking accuracy.

The Wisconsin State Highway Department has developed a set of specifications that rather closely follows the guide published by the U. S. Bureau of Public Roads. Every job requires individual specifications, however. It is unfair to a consultant in any engineering specialty to give him an assignment without clear and comprehensive specifications for the final product. If the instructions are clear, both parties are half way toward the realization of high-quality results.

In some respects, our specifications are more exacting than those of some states. For example, we require the establishment of five control points per model, whereas a minimum of three or four is generally specified.

We check the accuracy of maps submitted to us by making random inspections in the field. On completion of a mapping assignment, we turn the maps over to the district office involved and ask it to send a survey party out to the site. This party will run a number of profiles across the contour lines of the photogrammetric maps. Normally, one profile per sheet (½ to ¾ mile of centerline) is sufficient to indicate their reliability.

Of course the accuracy or inaccuracy of the entire job becomes very evident when the field crews get out there to stake the project for construction. Here is where a photogrammetrist's reputation stands or falls as far as we are concerned.

Our mapping requirements vary from year to year, as do those of any highway department. However, the level of prices over the past five years indicates that the market is stable and depends most on the complexity of the individual job. An analysis of average costs in this area reveals that we have obtained aerial photography for about $55 per sq mile, ground control for about $932 per sq mile, and mapping (all scales lumped together) for $764 per sq mile. Considering our strict requirements for accuracy and extra specifications, we are not unhappy with this picture.

Under a negotiating procedure such as that followed by Wisconsin, a large staff is not a prerequisite. Our Photogrammetry and Location Unit, which handles all matters of location and electronic computer operation, is a three-engineer office, headed by E. M. Every. In the past few years the staff has produced more than 300 mosaics from aerial photographs. This is one operation we handle internally.

The advantages of photogrammetric mapping over traditional ground methods have long been established. No matter how technically advanced an engineering method is, however, its advantages will be either realized or reduced by the procedures under which it is obtained. That is why, early in our experience with photogrammetry, we deliberately chose to negotiate for these highly specialized services, and why, we believe, the results have been so satisfactory.

THE READERS WRITE

Reactions on a pin-wheel frame

To the Editor: In the May 1960 issue, p. 108, a solution to Exam Gem No. 10 is given. This problem asked first for reactions, and second, for deflections due to a single concentrated load on a pin-wheel frame. The general solution to that type of problem, with an n-sided pin-wheel frame, simply supported on n columns and loaded with a point load P or a total uniformly distributed load P, can be obtained easily.

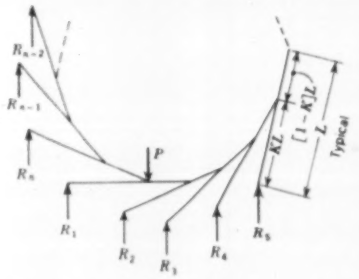


FIG. 1. Pin-wheel frame with n sides.

If R_r denotes the reaction at the rth column (Fig. 1), then for point load P,

$$R_r = P\,\frac{1-K}{1-K^n}\,K^{r-1}$$

$$r = 1, 2, \ldots n$$

For the total uniformly distributed load P, the reaction at the rth column is:

$$R_r = \frac{P}{2}\,\frac{1-K}{1-K^n}\,K^{r-2}$$

$r = 2, 3, \ldots n$, but r does not equal 1.

$$R_1 = \frac{P}{2}\left(1 + \frac{1-K}{1-K^n}\,K^{n-1}\right)$$

P. C. Dave, A. M. ASCE
Structural Engineer
The Kuljian Corporation

Philadelphia, Pa.

Notable civil engineers of the Civil War

To the Editor: For the next five years this country will be celebrating the one hundreth anniversary of the Civil War. This was the first war in which engineering was essential in the various campaigns.

It would be of great interest to have a series of articles prepared on some of the engineers who were prominent during the Civil War period. The following are suggested:

Herman Haupt (U.S. Military Academy, 1835), chief engineer of the Pennsylvania Railroad, who became Director of Military Railroads.

Gen. D. C. McCallum, who also was high up in military railroading.

William Sooy ("Baldy") Smith (U.S. Military Academy, 1853), who became chief engineer for the Army of Tennessee.

William D. Pickett, a charter member of ASCE, who became a colonel in the Confederate Army.

I would certainly be interested to read about these early civil engineers who, quickly and easily, became such effective military engineers.

Robert S. Mayo, F. ASCE
Colonel, U.S. Marine Corps Reserve
Lancaster, Pa.

Bridge clearances for missile transport

To the Editor: There has been considerable discussion on the subject of raising bridges to increase clearances for missile transport. It has been suggested that it might be less expensive to lower the roadway beneath the structure.

Another possible alternative, where clearances permit, is a depressed roadway in the median strip with a low-cost all-weather surface and special drainage provisions. For many sites the depressed "detour" may be an economical solution. At any rate, each structure should be considered individually so as to accomplish the necessary result as economically as possible.

R. Alan Berggren
Field Engineer
N. Y. Central Railroad

Chicago, Ill.

ENGINEERS' NOTEBOOK

Graphic solution for economic sizes of steel penstock

FRANCIS S. Y. LEE, F. ASCE

Ebasco Services, Inc., New York, N. Y.

Economic study to determine the size of penstock for a hydroelectric development generally requires that the annual penstock cost plus the value of power lost in friction be a minimum. Other factors involved include miscellaneous hydraulic losses, water-hammer effect, location of penstock, losses due to varying load factors, over-all plant efficiency, and future value of the power, etc. However, a much-refined analytical evaluation, taking all factors into account, may be neither justified nor practical since all the variables entering into the problem are subject to varying degrees of uncertainty.

Furthermore, in planning hydro power projects, engineers often need a short-cut estimate that will be sufficiently accurate for preliminary layouts. In such cases, the routine calculation with various schemes under consideration can be greatly simplified by the use of a graphical solution. This will serve as

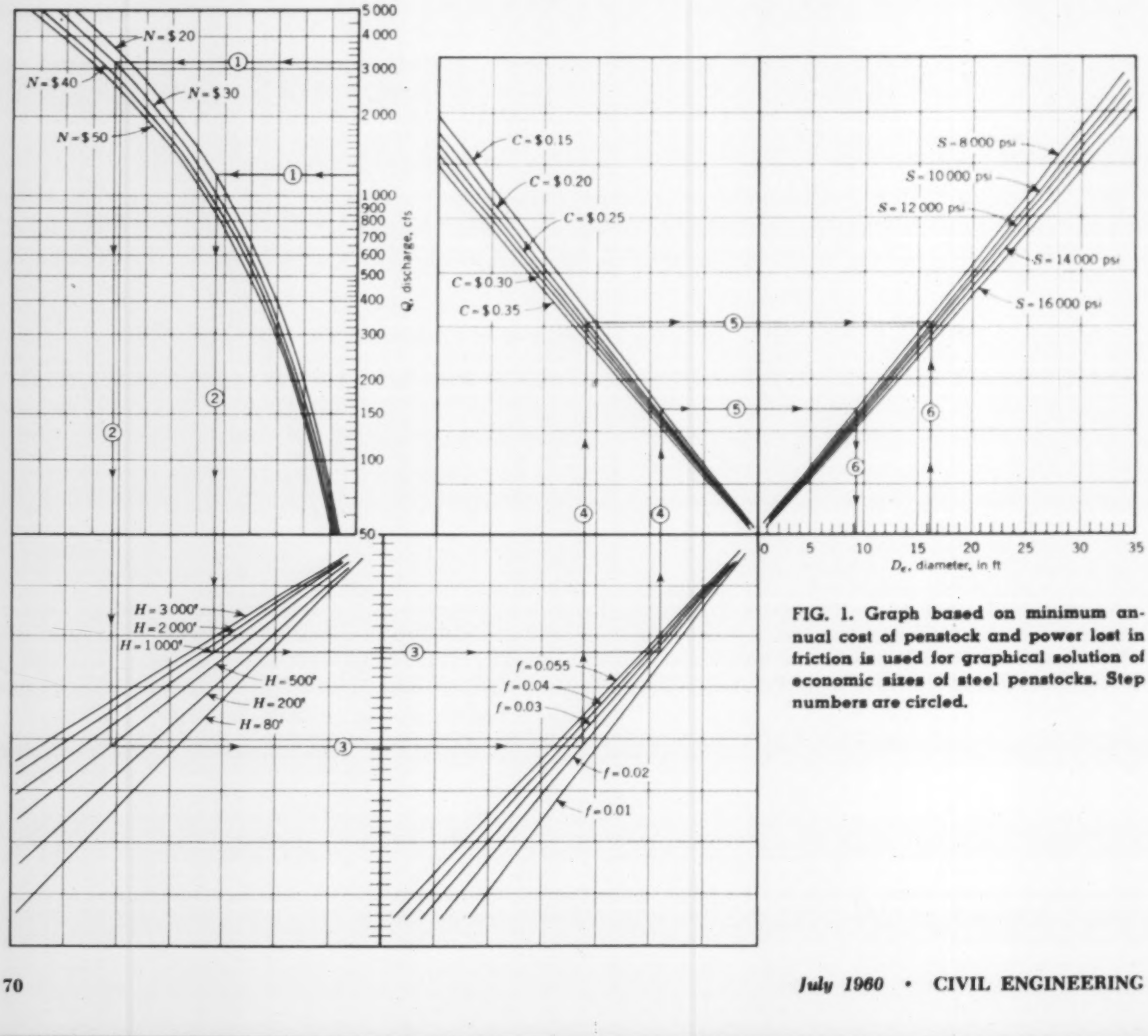


FIG. 1. Graph based on minimum annual cost of penstock and power lost in friction is used for graphical solution of economic sizes of steel penstocks. Step numbers are circled.

a good approximation for further detailed study.

To facilitate such a procedure, a graph based on minimum annual cost of penstock and power lost in friction is presented here as Fig. 1. The formula introduced by Prof. H. K. Barrows (see Barrows, *Water Power Engineering*, third edition, McGraw Hill, 1943, p. 379), is being used as a basis for the graph. The formula is

$$D_e = 0.215 \sqrt[7]{\frac{f\,N\,S\,Q^3}{C\,H\,I_{10}}}$$

where

D_e = economic size of penstock, in ft
N = value of power lost in friction, dollars per hp-year
f = friction coefficient, by the Darcy pipe-flow formula
S = allowable stresses, in psi
Q = discharge, in cfs
C = cost per lb of pipe, in dollars
H = head, in ft
I_{10} = yearly fixed charges on pipe, as a ratio, say 10 percent for the graph presented

Illustrative examples

Case 1. Given $Q = 1{,}200$ cfs; $N = \$20$; $H = 1{,}000$ ft; $f = 0.02$; $C = \$0.15$; $S = 8{,}000$ psi.

Determine D_e.

Step 1. Connect vertically $Q = 1{,}200$ on the Q scale with $N = 20$.

Step 2. Join horizontally with a straight edge the intersection point on $N = 20$ and $H = 1{,}000$.

Step 3. Extend this line to meet $f = 0.02$.

Apply the same procedure for Steps 4, 5 and 6. Read on the D_e scale 9.3 ft. The required diameter is 9 ft 4 in.

Case 2. Given $Q = 3{,}200$ cfs; $N = \$30$; $H = 500$ ft; $f = 0.02$; $C = \$0.2$; $D = 16$ ft 3 in. (say assumed D_e).

Determine S, the allowable stress for penstock design.

Use the same procedure as described for Case 1 except that Step 6 should be reversed to obtain the intersection point with Step 5 on $S = 10{,}000$ psi (in this case).

The resulting design stress is $S = 10{,}000$ psi.

For different values of yearly charges, I_x, using the following table:

I_x	F
11%	0.986
12%	0.973
13%	0.963
14%	0.957

The expression for economic size is then

$$d\acute{e} = F\, de$$

where
$$F = \sqrt[7]{\frac{I_{10}}{I_x}}$$

which is a proportional factor of different yearly fixed charges on pipe.

From the above explanation, it may be noted that for any possible combination of the seven affecting variables involved in a design (as indicated in the article), this graph will also result in obtaining the remaining dependent variable required by the design.

This graph was worked out in the metric system while the writer was Design Engineer for the National Resources Commission of China, in the U. S. Resident Office, Pittsburgh, Pa.

DESIGN CHART FOR HIGH-STRENGTH PENSTOCKS

Shortcut for preliminary estimates

JOSEPH T. GILCHRIST, M. ASCE, Senior Engineer, Bechtel Corporation, San Francisco, Calif.

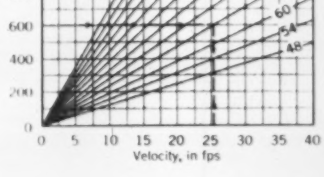
Design of free-standing steel penstocks requires many hours of detailed economic, hydraulic and structural analyses. However, when a preliminary design is prepared as a basis for a preliminary cost estimate, detailed analyses are not warranted. With desired simplicity in mind, the accompanying charts have been prepared for this preliminary use, they have proved to be especially helpful in studying alternative alignments. Although the principles on which they are based are not new, the charts include the features considered most applicable to modern practice. By means of these charts the weight of steel required for a given installation can be determined if the static head, the design flow, and the corresponding economic velocity for each section of penstock are known.

Determination of the most economic velocity for any head can be a complex procedure in itself. The most widely used methods express the economic velocity as a function of the design flow, unit head value, permissible stresses, friction, fabrication costs and amortization rate. In preliminary design it is often permissible to defer this detailed analysis and assume a range and distribution of velocities consistent with convention, but modified by a knowledge of the particular project.

Design velocities for a relatively long penstock are generally about 7 to 10 fps at the lowest heads and increase gradually to between 22 and 28 fps at the powerhouse, the rate of increase being greater as the powerhouse is approached. It may be helpful to remember that for any given penstock situation, a large design flow will often permit a somewhat higher velocity than a small design flow. However the experienced designer should have little difficulty in selecting reasonable velocities. A graphic expression of the flow equation, $Q = VA$, is provided in Fig. 1, which is included as a convenience in establishing pipe diameters for various design velocities.

The pipe design chart, Fig. 2, follows the modern trend in that it is

FIG. 1. Graph is an expression of the flow equation, Q = VA, and is used to determine pipe diameters for various design velocities.



based on the use of high-strength steel—in this case A212B, which permits hoop stresses up to 17,500 psi. Further, it applies only to full-welded construction with field stress relieving, or to welded pipe sections to be connected by sleeve-type mechanical couplings, and assumes no special lining. Similar charts can be drawn for any other steel and method of fabrication.

The basic equation for plate thickness is one of the more conservative ones:

$$h = \frac{4.6\ tf}{d + 2t}$$

where

h = maximum allowable static head on the pipe, in ft of water
f = allowable hoop stress, in lb per sq in.
d = inside diameter of pipe, in inches
t = design plate thickness, in inches

With an allowance of 15 percent for water hammer and 95 percent for joint efficiency, this formula is reduced to:

$$h = \frac{3.8\ tf}{d + 2t}$$

The weight per lineal foot of a section of penstock is determined by the formula,

$$w = 11.73\ (d + T)\ T$$

where

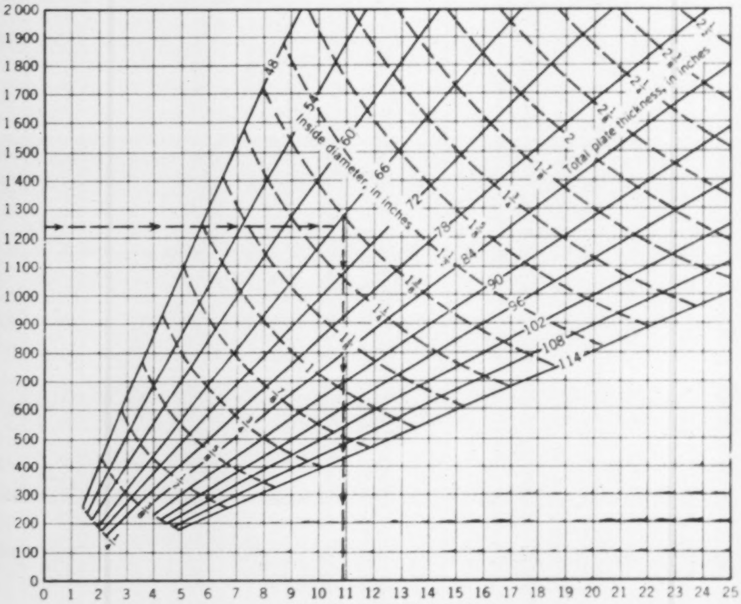
w = weight per lin ft, in lb
T = total plate thickness, in in.

The formula includes a corrosion allowance of $\frac{1}{16}$ in. in plate thickness and a 10-percent overrun for stiffeners, ring girders and expansion joints as required. The minimum total plate thickness is limited to $T_{min} = \frac{d + 20}{400}$ but in no case is it less than $\frac{1}{4}$ in.

Welded free-standing penstocks are usually shop fabricated and shipped in complete sections. The length, diameter, and weight of these fabricated "cans" are limited by the physical capacity of, and clearances and regulations for railroad flat cars, flatbed trucks, and handling cranes. The chart assumes a maximum can diameter of 9.5 ft, and most installations would limit the maximum length to 40 or 45 ft and the weight to about 40 tons.

In addition to the limitations on maximum size, note that the curves shown in Fig. 2 are prepared for 6-in. increments in pipe diameter and $\frac{1}{8}$-in. increments in plate thickness. Although interpolation for intermediate values is possible, it is not recommended since this would imply an unwarranted precision for preliminary estimates. Actually it might result in a more expensive penstock because of the greater number of fabrication sizes.

FIG. 2. Pipe design chart applies to penstocks made of A212B steel, permitting hoop stresses up to 17,500 psi. It applies only to fully welded construction with field stress relieving or to welded pipe sections to be connected by sleeve-type mechanical couplings.



As a brief example in using the charts, assume that the profile has been determined, saddles and anchors located, and the assumptions made for the distribution of velocities along the penstock. With a design flow of 600 cfs and an assumed section velocity of 26 fps, it is desired to know the weight of a penstock can located near the lower end of the profile at a static head of 1,240 ft. From Fig. 1, it is found that a pipe of 66-in. diameter produces a velocity slightly over 25 fps. From Fig. 2 is found a total plate thickness of 1$\frac{3}{8}$ in. and a corresponding weight of 1,085 lb per lin ft of penstock. A 40-ft can would weigh 21.2 tons.

A suggested procedure for using the chart for preliminary estimates follows.

1. Lay out the penstock profile, recording the static head as ordinate.
2. Place anchors as dictated by the layout and space intermediate saddles at even lengths of penstock can fabrication.
3. Estimate the velocity distribution and establish diameters with the assistance of Fig. 1.
4. Determine from Fig. 2 the head range for each diameter chosen and tabulate the maximum head for each plate thickness.
5. Read and tabulate the weight for each plate thickness.
6. From the profile, scale and tabulate the length of run for each plate thickness.
7. Multiply the unit weight of each fabrication by the corresponding length of run.
8. Total the weights of all fabrications to obtain the total weight of penstock steel.

Quantities for sleeve-type mechanical couplings, if such are required, are best prepared as individual items by tabulating the sizes and corresponding total heads to which each will be subjected. It is not generally advisable to estimate couplings solely on a weight basis.

For most preliminary estimates the main quantities that remain are clearing, excavation, and reinforced concrete for saddles and anchors. These items are dependent to a considerable extent on conditions at the site and a discussion of them is beyond the scope of this article. However, a knowledge of the terrain and a reasonable understanding of construction and structural practices should enable the designer to develop them sufficiently for the preliminary design estimate.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Hydraulics Division Conference

Co-hosts: Seattle Section, ASCE, and University of Washington

Health Sciences Auditorium, University of Washington, Seattle, Wash. **August 17-19, 1960**

ADVANCE INFORMATION ON ATTENDANCE

To help in planning adequate facilities for events at the Seattle meeting, the Conference Committee requests early notification of plans for attendance.

It will be appreciated if those who have not already given such notification will please fill out and mail the coupon on page 126.

REGISTRATION

Student Union Building

Monday, Aug. 15, 1:00 p.m. to 10:00 p.m.

Tuesday, Aug. 16, 10:00 a.m. to 10:00 p.m.

Student Union Building and Health Sciences Auditorium

Wednesday, Aug. 17, 8:00 a.m. to 4:00 p.m.

Thursday, Aug. 18, 8:00 a.m. to 4:00 p.m.

Friday, Aug. 19, 8:00 a.m. to 12:00 a.m.

Registration Fee $3.50. Ladies, children and students, no charge.

All conference sessions are to be held in the Health Sciences Auditorium.

WEDNESDAY MORNING

AUG. 17

Hydromechanics Session

9:00 a.m. to 12:00 a.m.

Presiding: Arthur T. Ippen, Chairman, Exec. Comittee, and Norman H. Brooks, Member, Hydromechanics Committee

Welcome: Harold E. Wessman, Dean of the College of Engineering, University of Washington

Report of Task Force on Aerated Flow in Open Channels

Frank B. Campbell, Chairman of Task Force; Chief, Hydraulic Analysis Branch, Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss.

Symposium on Mechanics of Ground Water Flow

Drainage Wells in Two-Layered Aquifers

C. E. Jacob, Groundwater Consultant, Los Angeles, Calif.

SKAGIT RIVER TOUR

Tuesday, Aug. 16, 7:00 a.m.

An all-day family tour of the Seattle City Light hydroelectric project in the northern Cascades. Rugged mountain scenery is combined with technical interest in the tour to view this integrated project which includes three dams, one under construction. The tour includes a meal at the project, and transportation by boat, bus, and inclined railway. Buses leave the Student Union Building at 7:00 a.m., and return to the University at 8:30 p.m.

Non-steady Flow Toward Wells Partially Penetrating a Water-Table Aquifer

Mahdi S. Hantush, New Mexico Institute of Mining and Technology, Socorro, N. Mex.

Salt Intrusion into Coastal Aquifers

Harold R. Henry, Assistant Professor of Civil Engineering, Mich. State Univ., East Lansing, Mich.

WEDNESDAY AFTERNOON

AUG. 17

Tidal Hydraulics Session

1:30 p.m. to 3:30 p.m.

Presiding: Eugene P. Fortson, Member, Exec. Committee, and Haywood G. Dewey, Jr., Chairman, Tidal Hydraulics Committee

Prototype Measurements, Columbia River Estuary

John B. Lockett, Corps of Engineers, North Pacific Div.; and, Harold A. Kidby, Corps of Engineers, Portland Dist., Portland, Oreg.

Detailed Current Studies in the Puget Sound Region

John Dermody, Senior Oceanographer, and Maurice Rattray, Associate Prof. of Oceanography, Univ. of Washington, Seattle, Wash.

A Calibration Method for a Hydraulic Model Subjected to Two Tidal Entrances

L. B. D. Terhune and N. E. J. Boston, Fisheries Research Board of Canada, Pacific Oceanographic Group, Nanaimo, British Columbia.

SALMON BARBECUE

Wednesday Evening, Aug. 17, 4:00 p.m.

Get-together informal social event for delegates, wives, and families. Boat trip across Puget Sound to salmon barbecue at Kiana Lodge. Transportation to be provided from the University campus.

THURSDAY MORNING

AUG. 18

Hydraulic Structures Session

9:00 a.m. to 11:30 a.m.

Presiding: Maurice L. Dickinson, Vice-Chairman, Exec. Committee, and Alvin J. Peterka, Chairman, Hydraulic Structures Committee

Effects of Cavitation and Negative Pressures on the Passage of Fish in Hydraulic Turbines

Glenn Von Gunten, Chief, Planning and Reports Branch, Corps of Engineers, Walla Walla Dist., Walla Walla, Wash.

Problems Associated with Water Temperature and Fish Passage

Milo C. Bell, Research Assoc. Prof., College of Fisheries, Univ. of Washington, Seattle, Wash.

Fish Protective Facilities at Tracy Pumping Plant, Central Valley Project, California

T. J. Rhone, Hydraulic Engr., U. S. Bur. of Reclamation Hydraulic Lab., Denver, Colo.; Daniel W. Bates, Fishery Research Biologist, U. S. Bur. of Commercial Fisheries, Portland, Oreg.

Chief Joseph Dam Stilling Basin—Damage and Analysis of Contributing Factors

Robert H. Gedney, Chief, Planning Sect., Corps of Engineers, Seattle Dist., Seattle, Wash.

THURSDAY AFTERNOON

AUG. 18

Hydrology Session

1:30 p.m. to 4:00 p.m.

Presiding: Herbert S. Reisbol, Water Resources Coordinator, and Franklin Snyder, Member, Hydrology Committee

Radar Observations of Topographic Effects on Precipitation in the Pacific Northwest

Fred W. Decker, Herbert Kershaw, Jr., and Wilfred G. Jensby, Science Research Inst., Oregon State College, Corvallis, Oreg.

Errors in Measurement of Reservoir Water Levels

Walter J. Parsons, Jr., Corps of Engineers, Sacramento Dist., Sacramento, Calif.

Fluctuations in Annual River Flows

Vujica J. Yevdjevich, U. S. Geological Survey, Washington, D. C.

Effect of Time and Space Distribution of Rainfall on the Runoff Hydrograph

J. Amorocho and G. T. Orlob, Dept. of Civil Eng., Univ. of Calif., Berkeley, Calif.

Conference Banquet

Thursday Evening, Aug. 18, 6:00 p.m.

Social hour and dinner for delegates and wives, Student Union Building. *Speaker:* Dr. Paul J. Raver, F. ASCE, Superintendent, Seattle City Light.

FRIDAY MORNING

AUG. 19

Flood Control Session

9:00 a.m. to 12:00 a.m.

Presiding: Carl E. Kindsvater, Member, Exec. Committee, and Francis G. Christian, Member, Flood Control Committee

Development of Spillway Design Flood for Bruces Eddy Dam, North Fork, Clearwater River, Idaho

Melvin J. Ord and Robert Conway, Corps of Engineers, Walla Walla Dist., Walla Walla, Wash.

Seasonal Runoff Forecasting of the Columbia River by the Coastal Flow Index Method

David M. Rockwood, Corps of Engineers, North Pacific Div., Portland, Oreg.

Flood Control Economics, Lower Columbia River

Kenneth Case, Corps of Engineers, Portland Dist., Portland, Oreg.

The Hydrology of Howard A. Hanson Dam and Reservoir

Norman J. MacDonald, Corps of Engineers, Seattle Dist., Seattle, Wash.

FRIDAY AFTERNOON

AUG. 19

Sedimentation Session

1:30 p.m. to 4:00 p.m.

Presiding: Harold M. Martin, Secretary, Exec. Committee, and Paul Benedict, Member, Sedimentation Committee

Formulas for Total Sediment Discharge of Alluvial Streams

Vito A. Vanoni, Prof. of Hydraulics, Calif. Inst. of Technology, Pasadena, Calif.

Transportation of Materials by Fluids in Pipe

A. R. Chamberlain, Chief, Civil Engineering Sect.; N. Yotsukura, Research Asst.; S. S. Karaki, Asst. Prof., Civil Engineering; and M. L. Albertson, Director, Research Foundation, Colorado State Univ., Fort Collins, Colo.

Stream Control Planning and Structures

Don C. Bondurant, Hydraulic Engr., Corps of Engineers, Missouri River Div., Omaha, Nebr.

Legal Aspects of Sedimentation

C. E. Busby, Water Program Specialist, Soil Conservation Service, Berkeley, Calif.

ACCOMMODATIONS

Rooms in University dormitories will be available at $3.50 per night, single (a limited number), and $5.00 per night, double. Children under nine years of age cannot be accommodated.

Many motels and hotels are located within five miles of the University. Hotel rates average $7.00 single, $9.00 double, and $10.00 twin, with no charge for children under fourteen. Motel rates are generally about $2.00 less than those for hotels, with a typical $1.00 per child increment.

For those who have not already given notification of tentative plans to attend the conference, the coupon on page 126 should be checked as to whether University dormitory housing, hotel housing, or motel housing is desired. While still available, advance reservations in the dormitories will be made for those indicating this type of housing. Information on hotels and motels will be sent to those who prefer this type of accommodaion. Actual reservations with hotels and motels must be made by the individual delegates to the Conference. It is therefore advisable to return the coupon on page 126 as quickly as possible.

LABORATORY OPEN HOUSE

The Charles W. Harris Hydraulics Laboratory (on which construction will still be under way), the Oceanography Laboratory, and the Fisheries Center Laboratories will be open for inspection on the afternoons of Thursday, Aug. 18, and Friday, Aug. 19. These laboratories are conveniently grouped, near the Health Sciences Building.

LADIES' PROGRAM

Tuesday, Aug. 16

7:00 a.m. Skagit River Tour

Wednesday, Aug. 17

10:30 a.m. Coffee hour, Student Union

11:30 a.m Campus tour

1:00 p.m. Luncheon, Faculty Club, with entertainment following

4:00 p.m. Boat trip, salmon barbecue

Thursday, Aug. 18

10 a.m. to 3 p.m. Scenic tour by bus

Includes Lake Washington Floating Bridge, Japanese Tea Garden, Art Museum, lunch at a waterfront restaurant. Delegates and older children welcome.

6:00 p.m. Conference banquet, Student Union

Friday, Aug. 19

10:00 to 11:30 a.m. Coffee hour, Student Union. Campus tour.

CHILDREN'S PROGRAM

Younger children: Arrangements have been made for all-day nursery school care. Sitters will be available at night.

Older children: Events will include a picnic, organized games, zoo trip, museum tour, and a YMCA Day Camp program. On August 18 there will be an evening party with dinner, dancing, and movies.

CONFERENCE COMMITTEES

Technical Program

Maurice L. Dickinson, *Chairman*

Enos J. Carlson, Emmett M. Laursen, Charles C. McDonald, Joseph I. Perrey

Local Committee on Arrangements

Eugene P. Richey, *Chairman*

Erdman Allen, Thomas Campbell, Harry Chenoweth, Edward Drobnack, Joseph Kent, Harrison Kramer, William Miller, Harold Morits, Ronald Nece, Mrs. Eugene Richey (representing the Ladies' Auxiliary, Seattle Section), Robert Seabloom, Howard Strausser

ASCE Past President Walter Huber Is Dead

Walter L. Huber, a noted civil and hydraulic engineer and former Society officer, died in San Francisco on May 30. A long-time friend of the Society, Mr. Huber served it with distinction as Director from 1922 to 1924, as Vice President in 1926 and 1927, and as President in 1953. As president of the San Francisco Section in 1936 and, later, as a member of the local legislative committee, he appeared many times before committees of the state legislature on matters affecting engineers.

A third-generation San Franciscan and graduate of the University of California, Mr. Huber was associated in his early career with the late John D. Galloway, Hon. M. ASCE, on many assignments in connection with the rebuilding of San Francisco after the earthquake and fire of 1906. This experience aroused in him an intense interest in earthquake-resistant design, which continued throughout his career.

Establishing his own consulting office in 1913, Mr. Huber concerned himself with the key problems of the growing West—among them water supply, conservation, and flood control. He was a pioneer in plans for the Central Valley Project, and construction engineer for San Francisco's Cherry Valley Dam. He was also responsible for the structural design of many large buildings on the University of California campuses and for numerous commercial buildings. He had been consultant to the Corps of Engineers and other government agencies on many important construction projects.

Walter L. Huber (1883-1960)

Employment Opportunities in Civil Engineering

Guest panel discusses civil engineering employment opportunities for the benefit of students attending the Annual Conference of Metropolitan Student Chapters, held recently at Newark College of Engineering as part of its 75th anniversary celebration. Panel members (from left to right) are Sidney W. Mosher, F. ASCE, chief engineer examiner, New York City Civil Service Commission; Joseph S. Ward, M. ASCE, consulting engineer of Caldwell, N. J.; Richard Mangasarian, M. ASCE, associate professor of civil engineering at N.C.E.; John W. Diercksen, engineer, Turner Construction Co., New York; and Paul A. Parisi, M. ASCE, editor, Technical Publications, ASCE.

EJC Makes Survey Of Employer Practices

The engineer generally is expected to determine for himself what information gained on one job may be utilized on a subsequent job—bearing in mind that he or his new employer may later be held legally accountable, according to a survey made by the Employment Conditions Committee of Engineers Joint Council.

Entitled "A Survey of Employer Practices and Expectations Concerning the Safeguarding of Proprietary Rights," the report presents the results of a questionnaire submitted to 800 major industrial companies that employ engineers.

Responses indicate that wide use is made of employment agreements which protect the current employer, but that only in rare instances are previous employee agreements investigated. "These former agreements, however, can form and have formed the basis for legal actions with both the engineer and new employer as defendants," the report points out.

The general attitude seems to be that reliance is placed almost solely on the terminating employee to distinguish between proprietary and general information.

Single copies of the report may be obtained free from Engineers Joint Council. Costs in bulk are available on request.

ASCE to Aid in National Water Pollution Conference

At the request of Arthur S. Flemming, Secretary of Health, Education and Welfare, ASCE has named a representative on the Steering Committee that will plan for the National Conference on Water Pollution, to be held in Washington, December 12-14, 1960. The ASCE representative on this vital committee is Edward J. Cleary, executive director of the Ohio River Valley Sanitation Committee, Cincinnati. Dr. Cleary has already met with the Steering Committee to start making plans for the conference.

The conference is being called on a directive from President Eisenhower. The directive asked Secretary Flemming to arrange for such a conference as a "forum in which all concerned can confront and better appreciate their mutual responsibilities for solving the pressing problem of pollution of the nation's watercourses."

Electronic Computer Applications

Once again Civil Engineering publishes descriptions of applications of electronic computers to the solution of civil engineering problems. These descriptions have been prepared from information assembled by the Task Committee on Program Directory and Library of the Structural Division's Committee on Electronic Computation. The present listing continues a series appearing in alternate issues (see the May issue, page 78).

To assist the Task Committee in its aim of assembling a comprehensive directory of computer applications in the structural engineering field, readers are invited to send information to: John J. Kozak, ASCE Task Committee, P.O. Box 1499, Sacramento 7, Calif.

Program St. 29: Computer analysis of continuous I-beam bridges

Equipment: Basic IBM 650.

Programmed by: The Iowa State Highway Commission, Ames, Iowa.

Purpose: To compute the stresses in a given line of beams, the length of positive and negative cover plates, the dead load deflections, the shears and reactions.

Method: The conjugate beam theory is used to write equations for influence lines for moment and shear. Using these influence lines the maximum positive and negative moments are computed and the stresses for the sections given. The cover plate lengths are then computed to the nearest 0.1 ft.

The program is divided into three sections. The first is used to compute moments, stresses, and cover-plate lengths. The second to compute dead-load deflections and the third to compute shears and reactions. AASHO standard truck and lane loads and military loading are used. Composite action is considered for live load.

Limitations: Symmetrical bridges; 30-ft spans and up. One positive moment cover plate per span; and four negative moment cover plates per pier.

Input-Output: Input is span lengths and load per beam. Output is all moments, stresses, deflections, shears, and reactions.

Machine Details: Written in SOAP II. Each section is self-restoring. Running time is 5 to 15 min.

Availability: Available to other highway departments only from: J. F. Hoag, Computing Center, Iowa State Highway Commission, Ames, Iowa.

Program St. 30: Analysis of circular, spirally reinforced columns

Equipment: Bendix G-15.

Programmed by: Scientific Computers, Inc., Minneapolis, Minn.

Purpose: To analyze and locate the neutral axis of a given circular, spirally reinforced, concrete column and to compute stresses in the concrete and steel according to the ACI Building Code (ACI 318-56) requirements.

Method: Column is checked for cracked and uncracked condition. Neutral axis is determined by successive iterations for cracked column. Then section properties and stresses are computed.

Limitations: Neutral axis is located within 0.01 in. This accuracy may be varied to any desired degree.

Input-Output: Vertical load on column, eccentricity of load with respect to the center of gravity of column, column diameter, area of steel, *n*, radius of steel reinforcement is required for input data. Output consists of transformed moment of inertia and area of cracked or uncracked column, neutral axis location, stresses in the tension and compression steel, maximum compression stress in the concrete.

Machine details: Programmed in INTERCOM 1000D, using about 500 commands and 50 storage locations. Running time is about 1.5 min including typeout.

Availability: For further information, contact: M. Turhan Taner, Scientific Computers, Inc., 1315-4th Street S. E., Minneapolis 14, Minn.

Program St. 31: Dead load deflection for structural members with variable moment of inertia

Equipment: Univac 120.

Programmed by: Bridge Div. Arizona Highway Dept.

Purpose: To give final dead load deflection at the eighth points of simple- or continuous-span bridges of concrete or steel.

Method: "Energy" method using AASHO Specifications for 1957.

Limitations: Uniformly distributed dead load. Maximum of eight changes of girder section.

Input-Output: Input includes: (1) moment of inertia at each section; (2) E times the moment at each end; and (3) the weight per foot for the steel and the concrete. Output includes: (1) The input data, and (2) the deflections at the eighth points due to the given loads and moments.

Machine Details: Programmed in basic machine language, using all 12 available storage locations. Running time is 20 sec per span.

Availability: Available through: Govt. Accts. Section, Remington Rand Div. of Sperry Rand Corp., 315 Fourth Ave., New York.

Program St. 32: Live load deflections for structural members with variable moment of inertia

Equipment: Univac 120.

Programmed by: Bridge Div. Arizona Highway Dept.

Purpose: To compute the maximum and allowable live load deflections for steel, concrete, or composite sections.

Method: "Energy" method using AASHO Specifications for 1957.

Limitations: Loading is either the H or H-S truck or the alternate interstate loading. Maximum of eight changes of girder section.

Input-Output: Input includes: (1) the weight of each wheel of the loading; (2) the location of each wheel; (3) E times the end moments of the girder; (4) the span of the girder; and (5) the moment of inertia of each change of section. Output includes: (1) the input data, and (2) the live load deflections.

Machine Details: Programmed in basic machine language using all 12 available locations. Running time 20 sec per span.

Availability: Available through Govt. Accts. Section, Remington Rand Div. of Sperry Rand Corp., 315 Fourth Avenue, New York, N. Y.

Program St. 33: Analysis and design of a reinforced concrete sewer

Equipment: Bendix G-15.

Programmed by: Chicago Department of Public Works, Chicago, Ill.

Purpose: To compute moments, thrust and shear for three different cases of loading and to determine the size and spacing of the transverse and longitudinal reinforcement.

Limitations: Symmetrical loading and shape about the vertical centerline of the sewer section.

Input-Output: Input includes the interior width or height of a given shape sewer section, the depth of earthfill over the crown, and the crown, side, and invert thicknesses. Output includes moments, thrusts, and shear for each case of loading. A table showing the bar sizes and spacing is also typed out.

Machine Details: Programmed in Intercom 103, using 800 commands. Running time, including the data input, is 30 min.

Availability: Bendix Users Group, c/o Winfield O. Salter, Parsons, Brinckerhoff, Quade & Douglas, 165 Broadway, New York 6, N. Y.

Program St. 34: Structural steel design

Equipment: IBM 650.

Programmed by: U. S. Army Engineer District, St. Louis, Mo.

Purpose: To compute the properties of the section formed by welding an angle or Tee section to a skin plate.

Method: Given the data on the angle or Tee and the limits of plate thickness, the program computes the properties of each section from the minimum to the maximum plate thickness in increments of 1/16 in.

Limitations: Accuracy to three decimals. Fixed decimal point throughout.

Input-Output: Input includes the data on the angle or Tee obtained from the steel handbook and the maximum plate thicknesses desired. Output includes, for the total section: (1) the moment of inertia; (2) the section moduli; (3) the location of the neutral axis; and (4) the area and the moment of the area of the plate about the c.g.

Machine Details: Programmed in basic machine language using 155 locations. Running time 1 sec. per section. Relocatable. Standard wiring panels.

Availability: This abstract is included through the courtesy of the Corps of Engineers with the understanding that the abstract itself is public property and not subject to copyright. This abstract is accordingly exempted from the general copyright notice applicable to this publication. Address inquiries: Department of the Army, Office of the Chief of Engineers, Engineer Data Processing Center, Washington 25, D. C.

Program St. 35: Modified truss analysis by method of joints

Equipment: IBM 650.

Programmed by: University of Houston, Houston, Tex.

Purpose: To analyze simple, pin-connected, determinate trusses. Will also analyze certain three-dimensional trusses for torque-type loads.

Method: Method of joints.

Limitations: Maximum number of members = 99; maximum number of joints = 56; maximum number of members meeting at a joint = 9; and maximum number of loads = 19. Will analyze leg members of tower-type structures for torque load for the following conditions: (1) the joints on the leg common to the adjacent faces coincide, and (2) the torque load is divided so that the moment due to the torque in each face is equal. Truss may be externally indeterminate at the base joints only. Joints must be numbered so that a solution by method of joints progresses from top to bottom.

Input-Output: The input consists of the coordinates of the truss joints, the joints at which each member ends, the type of member (leg, lacing, etc.) and the loads to be applied. The output is the axial force in each member, the horizontal and vertical components of that force, and the reactions.

Machine Details: Programmed in SOAP using the entire 2,000 available locations. Running time 1 to 5 sec per joint plus 0.6 sec. per member punchout time.

Availability: This program is available without charge. Refer to Program C103001A. Address: Computing and Data Processing Center, University of Houston, Houston, Tex.

Program St. 36: Analysis of twin box culverts

Equipment: Basic IBM 650.

Programmed by: The Iowa State Highway Commission, Ames, Iowa.

Purpose: To compute the minimum required thickness of walls and slab and to compute the area and cutoff length of all reinforcing steel using AASHO specifications.

Method: Conjugate beam equations are written for the unknown moments and are solved for 18 positions of live load, vertical dead load, and horizontal dead load. These moments are used to find maximum moment and shears. The required wall and slab thicknesses are computed. If these are larger than the current values, the program is repeated with larger sections. If not, all steel areas and cutoff lengths are computed and punched as output. AASHO standard truck and military loadings are used.

Limitations: From 0 to 99 ft of fill; up to 18-ft span (symmetrical).

Input-Output: Input is span, height, minimum acceptable thickness, depth of fill and live loading. Output is all bar areas, cutoff lengths, shear perimeter and thickness of the sections.

Machine Details: Written in SOAP II. Program requires two successive sections which must be reloaded for another run. Average running time is 45 min.

Availability: Available to other highway departments only from: J. F. Hoag, Computing Center, Iowa State Highway Commission, Ames, Iowa.

Program St. 37: Welded girder design

Equipment: IBM 650.

Programmed by: The Detroit Edison Co., Detroit, Mich.

Purpose: To compute the economical depth and proportions of the web and flange plates of a welded plate girder.

Method: Analysis follows the fundamental theory of beams.

Depth of web is calculated from $d = \sqrt[3]{\frac{M_{ax}}{fb}}$

Maximum moment = 30,503 ft = kips. Maximum of 42 concentrated loads.

Input-Output: Input data include the end reactions and the shear and moment at representative points along the span. Output data include the width and thickness of the flange and the depth and thickness of the web for each point where the shear and moment are given.

Machine Details: Programmed in basic machine language using approximately 900 locations. Not relocatable. Running time from 10 to 50 sec.

Availability: Available on a limited basis. Address: The Detroit Edison Co., 2000 Second Avenue, Detroit 26, Mich. Attention: Lloyd W. Coombe.

Program St. 38: Continuous bridge analysis

Equipment: IBM 650.

Programmed by: Oregon State Highway Dept., Salem, Ore.

Purpose: To analyze continuous beams or frames, with variable sections, of from two to five spans.

Method: Influence lines are developed utilizing Maxwell's Reciprocal Theorem and the Principle of Muller-Breslau. Live and dead loads are then applied and the moments and shears computed.

Limitations: Maximum of five spans. Program will not handle an abutment continuous with the end span.

Input-Output: Input includes: (1) the relative moments of inertia of the structure, the dead load, and the dimensions of the structure, or (2) for concrete structures, the dimensions of the section at each tenth point of each span, the superimposed dead load and the dimensions of the structure. Output includes: (1) gross moments of inertia when computed; (2) influence lines for moments, and the reactions, and the area under the curve; (3) dead load moments and shears; (4) live load moments for H20.S16-44 loading; and (5) deflection of each tenth point due to any loading.

Machine Details: Programmed in SOAP in several parts. Nonrelocable. No available memory locations. Running time about 12 min per span for the live-load routine and five to ten min for the other routines.

Availability: Available through the IBM 650 Program Library, 590 Madison Ave., New York 22, N. Y.

Program St. 39: Prestressed girder design

Equipment: IBM 650.

Programmed by: State of Nebraska.

Purpose: To design pretensioned, prestressed, concrete girders.

Method: Trial and error solution for prestressing force to produce allowable stresses. AASHO Specifications.

Limitations: Simple spans, composite design, pretensioned; standard girder sections; AASHO highway or special interstate loadings 3/8-in. or 7/16-in. strands at 250,000 psi ultimate.

Input-Output: Input includes: (1) uniform dead loads and type of live loading; (2) effective flange dimensions; (3) area of longitudinal reinforcing steel in flange; (4) distribution of loads; (5) concrete strengths; (6) type of girder section, and (7) span. Output includes: (1) max. and min. prestress force; (2) eccentricity at end and center of girder; (3) number and size of strands; (4) min. stirrup spacing; (5) horizontal shear; and (6) area of tensile reinforcing.

Machine Details: Programmed in SOAP, using approximately 1,500 locations. Running time less than 1 min.

Availability: Available only to tax-supported institutions. Address: State of Nebraska, Department of Roads, Computer Section, Lincoln, Nebr.

Program St. 40: Design of composite prestressed beams

Equipment: IBM 650.

Programmed by: Oregon State Highway Department.

Purpose: To compute the limiting values of the prestressing force for a composite beam.

Method: AASHO Specifications T.1 (58) Div. I, Section 13 were used.

Limitations: Design values are for mid-span only. Girder must be composite with the deck.

Input-Output: Input includes: (1) the physical dimensions of the beam, its span and spacing, the superimposed dead load, and the distance from the bottom of the beam to the c.g. of prestressing steel at mid-span, and (2) allowable stresses and the ratio of "N" values for the deck and girder concrete. Output includes: (1) the four limiting values of prestressing force for the four limits of concrete stress; (2) the ultimate prestressing force required to satisfy the ultimate moment; and (3) the properties of the composite section.

Machine Details: Programmed in SOAP, using 600 words of memory. Not readily relocatable. Running time one second.

Availability: For decks and instructions write: Data Processing Division, Oregon State Highway Department, Salem, Ore.

[*Editor's Note:* Program St. 22 (announced in the May issue) is available through an agreement with the University of Houston Computing and Data Processing Center for instructional and technical services associated with its use.]

Terrell Award Presented at District 9 Meeting

Both technical and professional matters were on the agenda at the recent two-day Conference of the District 9 Council, held in Columbus, Ohio. Presentation of the annual Daniel V. Terrell Award to John E. Wright, of the Indiana Section, for the best essay submitted by an Associate Member in the Council was a feature of the annual banquet. Mr. Wright's prize-winning paper on "The Civil Engineer's Civic Responsibility" will appear in an early issue. Shown, left to right, are Don Corbett and Joseph L. Perrey, of the Indiana Section; Craig P. Hazelet, of the Kentucky Section and ASCE Director for District 9; Joseph Hnot, president, Indiana Section; Otis D. Gouty, assistant to the Secretary of ASCE; and John E. Wright.

Engineering Foundation Elects New Chairman

Antoine Marc Gaudin, noted metallurgist and professor of mineral engineering at Massachusetts Institute of Technology, has been elected chairman of the Engineering Foundation, succeeding W. M. Peirce of New York City. Announcement of Professor Gaudin's election comes from Andrew Fletcher, president of United Engineering Trustees. Engineering Foundation acts as the research federation for the five major engineering societies, which are administered by UET.

George O. Curme, Jr., a director of the Union Carbide Corporation, will be vice chairman of the Foundation, and H. K. Work, associate dean and director of research at New York University, has been named director.

New Staff Officers for Welding Research Council

This past May, W. Spraragen retired as director of the Welding Research Council after many years of service in that capacity. He has been succeeded by Kenneth H. Koopman, for the past two years assistant director of the Council and executive secretary of the Pressure Vessel Research Committee. Charles F. Larson, Jr., a Purdue University graduate, has joined the staff of the Council in the capacity of secretary.

ASCE is represented on the Welding Research Council, which is set up under Engineering Foundation.

Corrections to ASCE Manual on Sewer Design

Attention is called to several corrections in ASCE Manual 37, entitled "Design and Construction of Sanitary and Storm Sewers," a joint publication of the Society and the Water Pollution Control Federation, issued in March (See June issue, page 80). The following changes should be made on page 209, under the heading "Factor of Safety":

1. Paragraph 3, lines 2 and 3, delete the word "non-reinforced."
2. Delete paragraph 4.
3. Add to paragraph 5: "A factor of safety of 1.25 should be applied to this maximum limiting deflection of 5 percent."

Albert Haertlein, Honorary Member of ASCE, Dies

Albert Haertlein, Hon. M. ASCE, former Society officer and a distinguished educator, died June 6 in his office at Harvard University. Professor Haertlein, who was 64, lived in Watertown, Mass. He was associate dean of engineering and applied physics at Harvard and an authority on the mechanics of structure. A graduate of Harvard, he joined the Harvard faculty in 1928 and become Gordon McKay Professor of Civil Engineering in 1940. He had been associate dean since 1951. He had been a member of the Board of Registration of Professional Engineers and Land Surveyors of the Commonwealth of Massachusetts since 1942, serving several times as chairman.

Professor Haertlein had served ASCE as Director and Vice-President, and became Honorary Member in 1956. This February he was given an Award of Merit by the Engineering Societies of New England "in recognition of his long and outstanding service to the engineering profession."

Professor Haertline held an honorary degree from Northeastern University, the Desmond Fitzgerald Medal of the Boston Society of Civil Engineers, and the Award of Merit of the National Council of State Boards of Engineering Examiners.

ASCE Membership as of June 9, 1960

Fellows	11,015
Members	16,058
Associate Members	18,307
Affiliates	100
Honorary Members	46
Total	45,526
(June 9, 1959	42,925)

ASCE Member on President's Committee for Traffic Safety

James C. Harding, F. ASCE, commissioner of public works for Westchester County, New York, has been appointed to represent the Society on President Eisenhower's Committee for Traffic Safety. Mr. Harding, who is widely known as an expert on highway safety, lives in Mt. Kisco, N. Y.

Metropolitan Section Host to Puerto Rican Engineers

Thirty engineering students from the University of Puerto Rico—in New York with their professors to study building techniques on construction projects—were guests of leading metropolitan engineers at a reception held in the Engineers Club early in June. Hosts were the Metropolitan Section and its newly formed Visitors Committee, which arranges inspection tours for visiting foreign engineers. In front row at extreme right are ASCE Director Elmer Timby and (next to him), Edward Dembitz, chairman of the Visitors' Committee. Director Thomas Fratar is at left in rear row.

The Younger Viewpoint

This month's editor is Albert C. Nelson, Zone II representative.

J. Wylly Keck, an engineer recently returned from a business trip to Europe, reports that European engineering education is set up different from what we are accustomed to here in the United States. They call the engineering student who has completed the study of engineering to the level of our Junior College, a Diploma Engineer. With this basic background he can begin his work in industry, usually from the bottom, until he has picked up enough practical knowledge to supplement his education and warrent a better position. If he chooses to finish his engineering education he becomes known as "Doctor," and without further examination is allowed to engage in the practice of engineering.

While most of the areas Mr. Keck visited seemed to be economically sound, and most of the people apparently living well, nevertheless a college education is a cherished prize. In the schools of Europe there appears to be considerably more self-discipline than elsewhere.

[*Editor's Note:* A comparative study of engineering education has been one of the important objectives of the Conference of Engineering Societies of Western Europe and the United States (EUSEC), which will meet in Brussels, August 29-September 3. The Proceedings of the Third (1957) EUSEC Conference note that, in Germany, "the Diplom Ingenieur, after completing the usual studies at a Technische Hochschule, is able to carry out development and research work and no further qualification is required, even for working on a thesis leading to the doctor's degree." Executive Secretary Wisely is current secretary of EUSEC.]

Surveyor or Surveyman?

Perhaps going unnoticed by some in the April issue of CIVIL ENGINEERING was a Letter to the Editor which dealt with one of the questions raised in Zone II's last turn at bat. In his letter from W. S. Dix, executive secretary of the American Congress of Surveying and Mapping, it is pointed out ". . . the heading 'Unions for Surveyors?' should more appropriately read 'Unions for Surveymen?' This would be in keeping with the subject, which relates to party chiefs, instrumentmen, and rodmen. The point is important in assisting the public to recognize the difference between professionals, technicians and aides, be it in surveying or in engineering in general."

The point Mr. Dix makes certainly is a good one, and "The Younger Viewpoint" appreciates the alertness which prompted the comment. If all of us engaged in the practice of engineering showed such diligence in attempting to reverse similar "false testimony" concerning Engineers appearing in communication media, we would not find ourselves so grossly misunderstood.

And Speaking of Communication

To encourage engineering students at the University of Miami, Coral Gables, Fla., to familiarize themselves with oral presentation of an engineering subject, the Miami Section has been in the practice of awarding a prize to the best of three papers presented before the Section. Along with the prize the student has the privilege of presenting his paper before the state convention of the Florida Engineering Society. This year's winner was Hugh R. Morgan, of Miami, for his paper entitled, "Traffic Assignment by Electronic Data Processing."

Help ! !

At the Local Sections Conference held in March in New Orleans, I had a discussion with Byron Spangler, president of the Florida Section, concerning the lag in contributions for the United Engineering Center in both the Florida Section and the Miami Section. There seems to be one question foremost in the minds of those asked to contribute. It goes like this, "How will it benefit me? I live 1,000 miles from New York, and will probably never see the building much less have the opportunity to use the library and other facilities."

Mr. Linzing Answers

Since the financing campaign for the UEC was initiated—over two and a half years ago—almost every issue of CIVIL ENGINEERING has sought to show why the engineering societies badly need a new building and why the profession needs a concrete symbol of its status in this Space Age. In brief:

1. The United Engineering Center will be a lasting monument to the entire engineering profession. It will symbolize the growing strength and growing unity of the profession.
2. The UEC will facilitate the activities and services of all the engineering societies. Additional space is badly needed by ASCE, by the other societies that share the present headquarters building, and by the Engineering Societies Library. The present headquarters building is forced to accommodate several times the number of employees it was designed for.
3. The Engineering Societies Library offers mail service to engineers living outside New York (no matter how far out!). In addition to book loans, the Library makes bibliographies, literature searches, translations, and photoprint and microfilm copies of Library material. On request, these will be sent air mail. For members of any of the Founder Societies, there are special discounts.
4. The "What's in it for me" attitude is unprofessional and completely at variance with the attitude that has made engineering the great profession it is. If such an attitude is the measure of a man's professional responsibility, then the word "professional" is misused.

Walker New Committee Member

As will be noted on the masthead, William R. Walker is the new Zone III representative on the Committee on Younger Member Publications. Mr. Walker is a member of the Illinois Section and is employed by the Portland Cement Association in Chicago. In addition to being an engineer, he is also a lawyer and member of the Chicago and American Bar Associations. He received both his B.S. in C.E. and L.L.B. degrees from the University of Nebraska. Next month's article will be written and edited by Mr. Walker.

Committee on Younger Member Publications

Walter D. Linzing, Chairman; 4751 No. Paulina, Chicago 40, Ill.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko **289 Foxhill Road** **Denville, N. J.**	**Albert C. Nelson** **250 N.E. 51st Street** **Miami, Fla.**	**William R. Walker** **4600 Franklin Ave.** **Western Springs, Ill.**	**Judd Hull** **3178 Almeria** **San Pedro, Calif.**

HOW
TO
HANDLE
WET
JOBS

Project: Sewage Treatment Plant Extension, Bay Park, N. Y.
Contractor: Hendrickson Bros., Inc., Valley Stream, N. Y.

6-ACRE PLANT ADDITION DEWATERED FROM ONE CENTRAL PUMP STATION

Economy of operation was imperative in dewatering the above-pictured job site, which is located on water-logged Long Island's tidal flats. Hendrickson Bros. called for a wellpoint system which would predrain 3 separate areas, totaling more than 6 acres, from one central pump station.

- On many previous occasions, including the dewatering for the main plant at this same location in 1950, Hendrickson Bros. had successfully handled difficult wet work with Griffin equipment.

- Griffin was called upon to design and build pumps with extra air-handling capacity. With these pumps, operating from a single pump station, one wellpoint stage lowered 19 ft of ground water throughout the main excavation area. That's *low*-cost dewatering—by Griffin.

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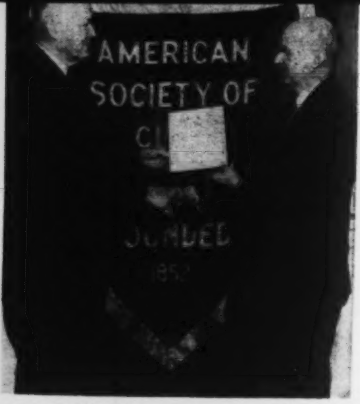
25th YEAR

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)



Horace W. McCurdy (left) is honored by the Seattle Section as the "Outstanding Civil Engineer of the Year." Fred H. Rhodes, ASCE Director for District 12, made the presentation at a recent Section meeting, which also featured a talk by Dr. Ralph B. Peck, of the University of Illinois, on the difficult soil conditions encountered during the relocation of the Northern Pacific Railway line near the Noxon Rapids Dam on the Clark Fork River.

John J. Gallen (right), new president of the Philadelphia Section, receives gavel from his predecessor in office, Alfred A. Estrada. Other new officers are Sidney Robin, vice president; Lt. Col. Clyde B. Pyle, secretary; Nevile C. Courtney, treasurer; and Theodore Davis, membership secretary. Alfred G. Graves and Richard Z. Zimmermann are the new directors.

At its May meeting the **Akron Section** voted unanimously to send a letter to the president of the Akron Council, protesting the proposed formation of a new Bridge Maintenance Division, which would not necessarily be under the direction of a registered civil engineer and which would answer to the Service Director, a politician rather than an engineer. The technical program featured a joint talk by John Koogler and James Titmas on their pollution study of Summit Lake. Larry Spencer, a senior at the University of Akron and winner of the Section's Memorial Award, spoke on a hydrologic study of the lake.

Eight members of the **Arizona Section** recently received "Award of Merit" medallions from the University of Arizona which is observing its 75th anniversary. The awards went to G. L. McLane, William E. Willey, John A. Carollo, Dario Travaini, Harold W. Yost, Wayne G. O'Harra, Earle V. Miller and Ralph A. Hoffman. A photo of engineers O'Harra, Miller and Hoffman receiving their medallions appeared in the June issue.

The **Kansas City Section** is planning another of its ambitious and successful annual conferences. This one will be a Power Conference, at the Continental Hotel, Kansas City, Mo., November 10 and 11. Ray Lawrence is chairman, and Robert O. Drange, publicity chairman.

Members of the **Illinois Section** met on May 5 at the Engineers Club in Chicago to organize a Soil Mechanics and Foundations Group. The attendance included Dr. J. O. Osterberg, chairman of the Executive Committee of the ASCE Soil Mechanics and Foundations Division, who discussed the organization and puropse of the ASCE Technical Divisions. About four technical meetings a year are planned with the first scheduled for early summer. The chairman of the Group is Dr. L. A. DuBose, the vice-chairman, Marvin H. Salisbury, and the secretary, David Novick.

The **Metropolitan Section** installed new officers at its recent annual meeting. The incoming president is Robert H. Dodds, project engineer for Gibbs and Hill of New York, and Malcolm Pirnie, Jr., sanitary consultant, is a new vice president. Col. William J. Shea remains as treasurer, and Brother B. Austin Barry begins his third term as secretary. One of the Section's major projects this year will be the efficient operation of the Engineering Visitors' Committee, intended as an aid to foreign engineers who wish to inspect the great construction projects for which the New York area is

Robert Dodds

(Continued on page 84)

At a recent meeting of the Los Angeles Section ASCE Director Trent R. Dames (left in left-hand view) presented a charter for the new newly formed Student Chapter at the University of California, Los Angeles, to C. Martin Duke, associate dean of the College of Engineering, and William Goddard, president of engineering students at UCLA. Photo at right shows Director Wayne O'Harra presenting three of the Society's 1959 awards—the Collingwood Prize, the Research Prize, and the J. C. Stevens Award—to Dr. Norman Brooks, of the California Institute of Technology staff and recipient of all three honors for his outstanding work in the fields of hydraulics and fluid mechanics. Dr. Lee A. DuBridge, president of Caltech, was featured speaker.

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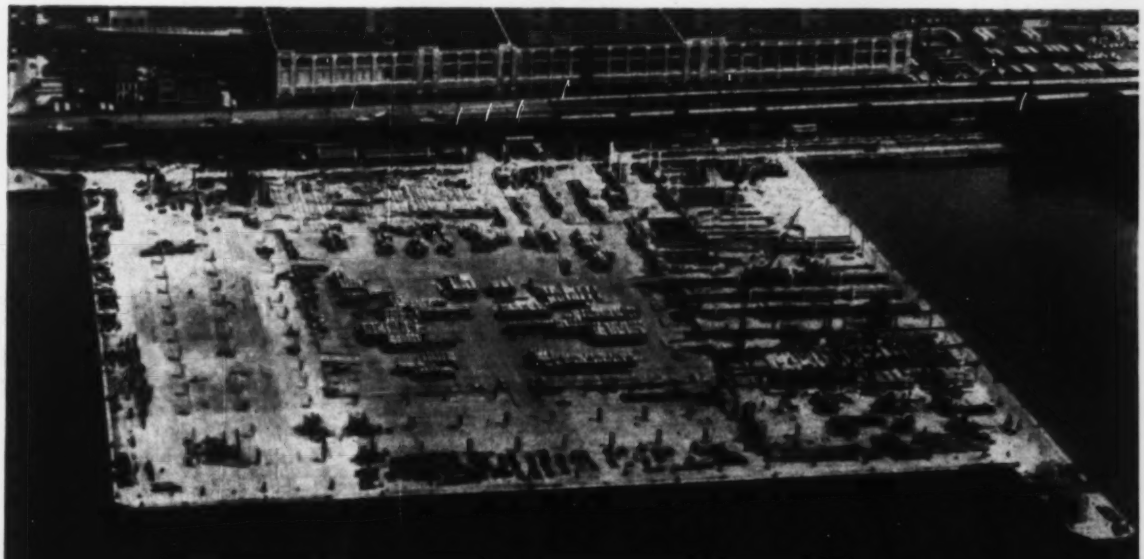

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The substructure of new Pier No. 40 is comprised of 6000 prestressed deck slabs uniquely placed upon a monolithically poured-in-place beam and cap system. The floor area is over 700,000 sq. ft.

- **SONOTARD** is being used in *all* concrete to produce consistent and uniformly high strengths required for the heavy live loads to be handled, plus maximum density to resist erosion from sea water.
- A high degree of workability to facilitate placement has been maintained through high summer heat and a winter which recorded a low mark for sustained cold weather.
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- **SONOTARD** speeded the strength development (15 hours of steam cure averaged over 4500 psi) permitting early release of tension and early stripping of forms.
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world famous. At the same meeting, John M. Kyle, Jr., chief engineer of the Port of New York Authority since 1947, received the Section's citation as "Metropolitan Civil Engineer of the Year." During the past year Mr. Kyle has been responsible for engineering work on the lower level of the George Washington Bridge; the bridge's complex approaches and nearby bus station; new hangars and instrument runways at New York International Airport; and extensive construction at the Brooklyn and Elizabeth Port Authority piers. Capt. Emil H. Praeger, cited as Metropolitan Engineer of the Year in 1952, was the evening's principal speaker.

The Feather River Project field trip, undertaken by the **Marysville Branch** of the **Sacramento Section** on April 30 was a huge success. Approximately 40 members and guests inspected the highway and railroad construction which has been completed to date, including the extensive tunnel work and the railroad and highway bridges. The Branch hopes that an annual trip can be scheduled each spring until the entire project is finished.

Over 200 members of the **Texas Section** gathered recently in Midland, oil capital of west Texas, for the spring meeting of the Section. The theme of the meeting was the civil engineer in the oil industry, or how the well-oiled civil engineer works. The Midland meeting was very fortunate in having exceptionally fine speakers on non-technical subjects, such as the welcoming address by A. Alex Bul, city manager of Midland, and the fine talk on professionalism by Bernhard Dornblatt, ASCE Director for District 15. A speaker greatly enjoyed by all was Delbert Downing, manager of the Midland Chamber of Commerce. Mr. Downing, speaking on prejudice, combined humor and serious intent in a tale both entertaining and thought provoking. On Friday and Saturday the Section's Sanitary, Soil Mechanics and Foundations, Hydraulics, and Structural Groups presented a superior group of papers.

ASCE CONVENTIONS

ANNUAL CONVENTION

Boston, Mass.
Hotel Statler
October 10-14, 1960

PHOENIX CONVENTION

Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

ANNUAL CONVENTION

New York, N. Y.
Hotel Statler
October 16-20, 1961

DISTRICT CONFERENCES

DISTRICT 9 COUNCIL
Cleveland, Ohio
Sheraton-Cleveland Hotel
August 6-7, 1960

TECHNICAL DIVISION MEETINGS

HYDRAULICS CONFERENCE

Seattle, Wash.
University of Washington
August 17-19, 1960

Sponsored by

Hydraulics Division

CONFERENCE ON ELECTRONIC COMPUTATION

Pittsburgh, Pa.
Hilton Hotel
September 8-9, 1960

Sponsored by

Structural Division

About 75 members of the Toledo Section turned out recently to watch a demonstration of various unusual civil engineering applications of the electronic computer. Charles E. Shapler, seated, technical director of Caltec, Inc., Toledo electronic computer services firm, shows Leo V. Campbell, on the right, the whys and hows of the computer. Caltec vice-president Fred C. Miller looks on.

Syracuse Section Past President Lewis Dickerson (right) presents the Section's annual award "to a prominent civil engineer in the area" to Earl O'Brien, ASCE Director for District 3 and principal in the engineering firm of O'Brien and Gere, as Mrs. O'Brien looks on. During the evening a Life Membership Certificate was given C. D. Murray.

BY-LINE WASHINGTON . . . . .

Fast action by ASCE and other professional groups got fast results in removing a major threat to civil engineering ethics from proposed amendments to armed services procurement laws. Protests by the professional societies were successful in eliminating changes to existing regulations.

What got the societies excited were provisions in two bills (H. R. 12299 and H. R. 12345) that were technical and quite obscure on casual reading: they affected some of the subparagraphs in Section 2304 (*a*) and other parts of the U.S. Code. On careful reading it became apparent that the effect would be a requirement for bidding on engineering services, particularly since contracting agencies would be required to justify their actions, in writing, on a cost basis. Formal protests to the House Armed Services Committee resulted in a "committee bill" (now numbered H. R. 12572) which omitted any changes affecting present practices on obtaining engineering services.

* * *

Cutting down appropriations is one way to cut construction costs, according to Senator John Stennis (D. Miss.). At least, Senator Stennis told the Senate, it worked on military hospitals. Discussing committee action on the $1.07 billion military construction appropriations bill, he said ". . . in the bill last year, authority was requested for several hospitals at costs far in excess of known costs for Hill-Burton civilian hospitals. The committee made . . . cuts . . . approximating 20 percent or more. . . .We now find that the services have been able to get along with the amounts granted. . . . This simply shows, in respect to many areas of military construction, that if some segment of Congress simply takes out after a point . . . a saving is made. . . ."

The two biggest individual construction jobs to come out of this session's legislative activity will both be in the West—California's $2.1 billion San Luis Project, and a new international dam on the Rio Grande near Del Rio, Tex. Congressional approval of a partnership agreement (whereby the U.S. will put up some $290 million, California, $1,700 million) for development of northern California waters that will be partly pumped to the southern part of the state is a real "first" in this field. The $100-million-plus dam to be built on the Rio Grande, about 300 miles upstream from Falcon Dam, will represent $71 million of U.S. money, for flood control and power development. Next stop, on both projects, will be to reach agreements among the governmental agencies concerned.

Another major source of construction is also well on its way to becoming a fact, as Congress swings into its final weeks: The Senate, with some reservations, approved U.S. participation (to the extent of $320 million) in the $1 billion International Development Association, scheduled to become a new lending agency for aiding underdeveloped Latin-American nations.

* * *

A turnpike authority isn't necessarily a part of the state government, the U.S. Supreme Court has ruled—and that makes a great difference to anyone who may have occasion to sue such an authority. A case involved a contractor who claimed "extras" and the Kansas Turnpike Authority. The Authority contended—among other things—that it is a part of state government, thus could not be sued in district courts without its consent. Not so—in Kansas at least—said the High Court. The Kansas Authority has no taxing powers, and is "specifically divorced" from the state government under its organization authority. Hence, said the Court, (in a 5-4 decision) the authority is a "citizen" of the state and may be sued in lower courts.

* * *

The Federal Aviation Agency has called a flat halt to any further runway lengthening. According to Deputy Administrator James T. Pyle, the present 10,800-ft authorized length is final. "This is our last increase," he said, "we shall not provide federal aid . . . to solve aviation's problems by adding more pavement. . . . New aircraft will have to have greater power—but, be assured they will operate from those 10,800-ft runways. . . ."

* * *

Congress is getting ready to call a halt to the deepening of inland waterway channels. In its report on the Army's Civil Works Appropriation Bill, the House Appropriations Committee commented on the fact that ever-larger freight vessels are making their appearance on the waterways." These developments are aimed at reducing freight costs," said the report, "but they are inevitably followed by demands for channel deepening and rectification. It is the committee's hope that efforts will be made to establish guide lines or standards, limiting ultimate depths of channels beyond which the federal government will not deepen further, without contributions on the part of the principal beneficiaries.

* * *

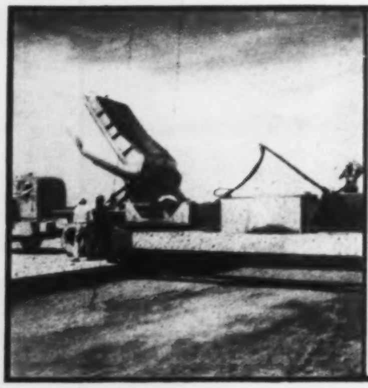
The Atomic Energy Commission is breathing easier these days since surveys of a shallow-water disposal area for radioactive wastes, 15 miles off Boston Harbor, have shown no radioactivity attributable to the disposal operations. (The site was abandoned in August 1959, and disposal is now handled off the Continental Shelf). Nevertheless, the AEC has joined seven other agencies to make a comprehensive survey of the Clinch River, downstream from Oak Ridge, Tenn., to check health and safety aspects of low-level radioactive wastes discharged to solution to the river. It has also just designated new "interim" land burial sites at Oak Ridge and Idaho Falls, Idaho, for disposal of solid, packaged radioactive wastes.

* * *

Engineering interest in that $34 million, five-year research program suggested in a report to the Highway Research Board, centers on the subject of aggregates. The report recommends that nearly a third of the total to be expended—$10 million to be exact—be spent on research into aggregates, particularly to see if nuclear energy may be useful in transforming unsuitable materials in useful aggregates. Incidentally, the Board found that about $17.8 million is being spent annually, right now, on research in the highway field.

FOR RUNWAYS WITH
A SOLID FUTURE...
Concrete

Dulles Airport designs for jet age ...concrete meets runway needs of



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- Minimum acceptable life of 25 years
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- Adaptability of pavement to accommodate probable characteristics of future aircraft

More than six miles of concrete runways are now under construction at Dulles International Airport

with CONCRETE nation's first airport built for jets

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Built from the ground up for jets! Dulles International Airport near Washington, D.C. will handle peak traffic day after day. Runways stretch more than two miles long. High-speed turnoffs sweep planes clear of the runway within 30 seconds of touchdown. *All runways and taxiways are designed to handle aircraft weighing up to five hundred thousand pounds!*

Only concrete could do the job. It's the one pavement that enables engineers to accurately design runways to match *any* traffic load. Pilots prefer concrete, too. Safety is built in. There is dependable skid resistance, wet or dry. Light color for highest visibility. A surface that stays forever flat.

And not the least advantage is long-time economy. Concrete's moderate initial cost isn't just a down payment. Upkeep costs will remain low. For airport paving, for important highways like the new Interstate System, concrete is the preferred pavement on every count.

PORTLAND CEMENT ASSOCIATION *A national organization to improve and extend the uses of concrete*

News Briefs . . .

Chile Earthquake Spreads Disaster Round the World

The disastrous series of earthquakes that struck Chile late in May has brought death and destruction to countries on the perimeter of the entire Pacific. In the wake of the earthquakes, great tidal waves—up to 50 ft high and traveling at jet speeds of 525 miles an hour—caused extensive damage to Pacific ports, from Japan to California and from Alaska to New Zealand. The waves that wrecked the coastal villages of Japan a third of the way around the world were 32 ft high. In both Japan and Hawaii, which was struck by four waves, there was serious loss of life and extensive property damage.

The U.S. Coast and Geodetic Survey, which monitors earthquake activity and warns of tidal waves—or tsunami, as they are known to scientists—warns that the entire Pacific coastline will be a danger area for the next few years. According to the Survey, there is a zone of earthquake activity reaching from Alaska to Chile and from Japan to the Fiji Islands. This activity results in some twenty major and thousands of small earthquakes, or tremors, a year and an extremely serious disturbance on an average of once in two years. Fortunately most of the earthquakes take place in the depths of the ocean and do not cause any damage. It is when they occur in shallow coastal waters that disastrous tidal waves are generated.

In Chile, where the earthquake struck with a force said to compare with the effect of 25,000 atomic bombs of the Hiroshima type, the toll of dead and missing is put at upward of 5,000, and property damage at some $400 million. An area about the size of New York State—roughly one-third of the country—was destroyed. Sleeping volcanoes were activated and new ones formed. In fact, the disaster has altered the entire map of Chile, causing sharp changes in the ground level and shifting shorelines, hills, valleys, and islands. The city of Valdivia, formerly a river port, has become a seaport, subject to ocean tides, and various parts of the city are reported to have sunk as much as 10 ft.

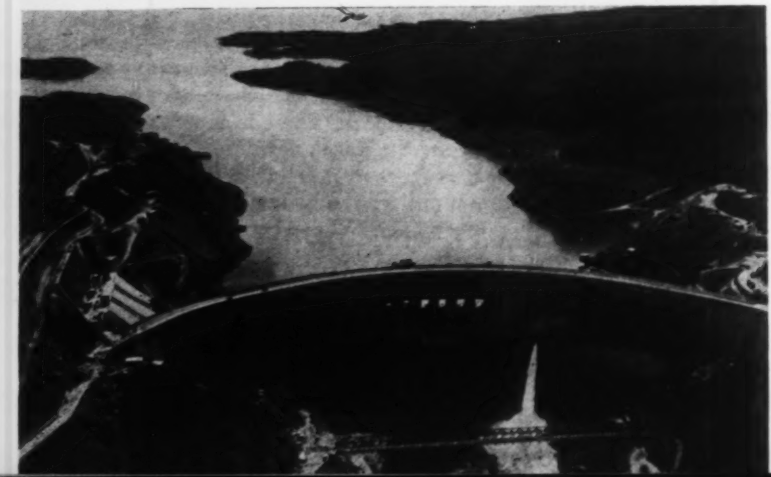
Measured on the Richter scale, the five biggest Chile earthquakes ranged between 7.25 and 8.5. Anything over 7 is classified as "major." The worst earthquake on record—that taking place at Assam, India, in 1950—had an intensity of 8.7.

Concepcion and Puerto Montt bore the brunt of the Chilean earthquake. In Puerto Montt a number of concrete frame structures survived the quake, though a recently completed nine-story reinforced concrete hotel cracked open from roof to foundations. Concepcion has been destroyed by quakes five times in its recorded history. When it was last rebuilt, in 1939, its buildings were designed to withstand quakes, and engineers will be interested in seeing how well they have stood up.

One member of ASCE is known to have lost his life in the tidal wave that hit Hilo, Hawaii. He was James K. Look, a young Honolulu engineer, who recently became an Associate Member. Mr. Look drowned on the beach at Hilo, where he had gone to gather first-hand information on the seismic wave for the Army Corps of Engineers. He was engaged on the design of a seawall to protect Hilo from future wave damage. Mr. Look's obituary appears in this issue.

Kariba Hydroelectric Project Is Dedicated

Africa's Kariba Dam and Hydroelectric Project—on the Zambesi River between Northern and Southern Rhodesia—was formally placed in operation by Queen Mother Elizabeth on May 17. The $224,000,000 project was started in 1955, and the first stage will be completed late this year. When the second stage is completed, probably by 1970, the project will be the largest hydroelectric development in Africa and one of the largest in the world. The dam is a concrete arch with maximum height of 420 ft and crest length of 1,900 ft. The 175-mile-long reservoir, which is filling now, will store about 130 million acre-ft of water—more than four times that stored in Hoover Dam. The two underground powerhouses will have an ultimate capacity of 1,500,000 kw. A 930-mile network of transmission lines will carry this power from Kariba to the copperbelt and to communities in Northern and Southern Rhodesia. Design and engineering for the project were supplied by an international civil engieering group under the name of Gibb, Coyn and Sogei (Kariba), ltd.



May Construction Down From May 1959 Level

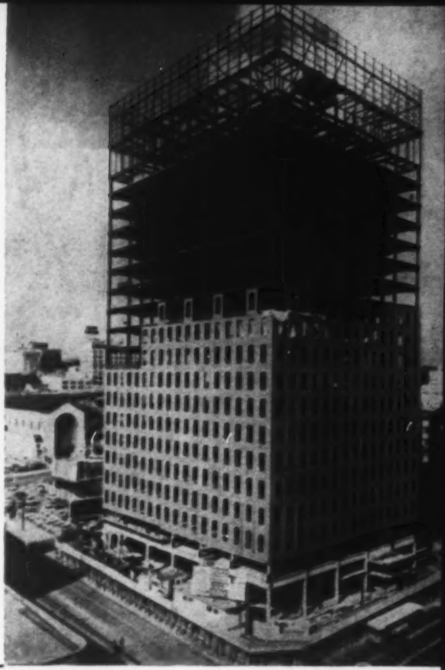
Although the $4.5 billion spent for new construction this past May was 10 percent above April expenditures, it was 5 percent less than construction outlays in May 1959. Similarly, the cumulative value of construction expenditures for the first five months of this year were 2 percent below spending in the comparable period of 1959.

Spending for new private construction this May was 8 percent above the April level but 4 percent off from May 1959 expenditures. Private spending for the first five months of 1960 represented a 1 percent increase from the 1959 level in the same period. Public construction expenditures for May registered a 7 percent decline from May 1959, and spending in the first five months of 1960 was down 11 percent from the same period of last year.

These figures are from the U. S. Department of Commerce's Bureau of the Census.

Los Angeles Skyscraper Features Seismic Design

Newcomer to the Los Angeles skyline is the $15,000,000 Tishman Realty and Construction Company's 22-story Wilshire-Flower Building in the downtown area. The building, the tallest to go up since the city relaxed its 13-story limitation on building heights, has been specially designed to resist wind and seismic forces. All exterior walls—composed of individual prefabricated, steel-framed panels of plaster and glass mosaic tile—are designed to withstand lateral movement. Both horizontal and vertical movement can be accommodated in the wall panels, which are framed with 3-in. channels. Since any expected panel movement would not involve adjacent panels and floors, shearing forces resulting from lateral displacement of the floors will not affect the walls. Engineering is a joint venture of the Los Angeles firms of Victor Gruen Associates and Daniel, Mann, Johnson & Mendenhall. Bethlehem Steel Co. fabricated and erected the 3,350 tons of structural steel required.



AASHO Road Test To Be Extended

The test traffic phase of the AASHO road test at Ottawa, Ill., has been extended five months—to the end of November 1960. It had previously been announced that test traffic would end on July 1, after approximately 20 months of operation. The road test, which is said to be the largest and most comprehensive highway research project ever undertaken, is sponsored by the American Association of State Highway Officials and administered and directed by the Highway Research Board.

The new schedule will enable the project to meet its original goal of two years of tests and a million axle-load applications. To date the project's test vehicle fleet has traveled nearly 11,000,000 miles, and there have been about 700,000 axle-load applications on the pavement test sections.

Lock and Dam Renamed to Honor W. H. McAlpine

The Louisville Locks and Dam, a project of the Army Corps of Engineers at Louisville, Ky., will be renamed the McAlpine Locks and Dam after William H. McAlpine, Honorary Member ASCE and a civilian employee of the Corps of Engineers for half a century. Mr. McAlpine, who was affectionately known as "Mr. Mac" among his engineer associates, died November 1, 1956, at the age of 81. While in the Ohio River Engineer Division, he was associated with the construction of the locks and dam that will bear his name. Mr. McAlpine's career culminated in nine years as special assistant to the Chief of Engineers in Washington.

Renaming the Louisville Locks and Dam in his honor was authorized by a recent act of Congress.

Metric System Explored at EIC Annual Meeting

A thousand members and friends of the Engineering Institute of Canada gathered for the 74th Annual General and Professional Meeting, held in Winnipeg late in May. Every province was represented, as were fellow societies in the United States and Great Britain. Max Freedman, of the British *Manchester Guardian*, came from his post in Washington to speak at the annual banquet, at which the Mayor of Auckland, New Zealand, was among the head table guests.

Yard or Meter—Which?

The highlight of the technical program was a panel discussion on the pros and cons of the metric system. Taking part were D. S. Young, president of Powerlight Devices, Ltd., Toronto; J. M. Thomson, chairman of the board of Ferranti-Packard Electric Ltd., Toronto; H. A. Young, deputy minister of public works, Ottawa; L. E. Howlett, of the National Research Council, Ottawa; and G. L. d'Ombrain, of the electrical engineering department at McGill University, Montreal. The timely session attracted an overflow audience. The conclusions reached have not been reported.

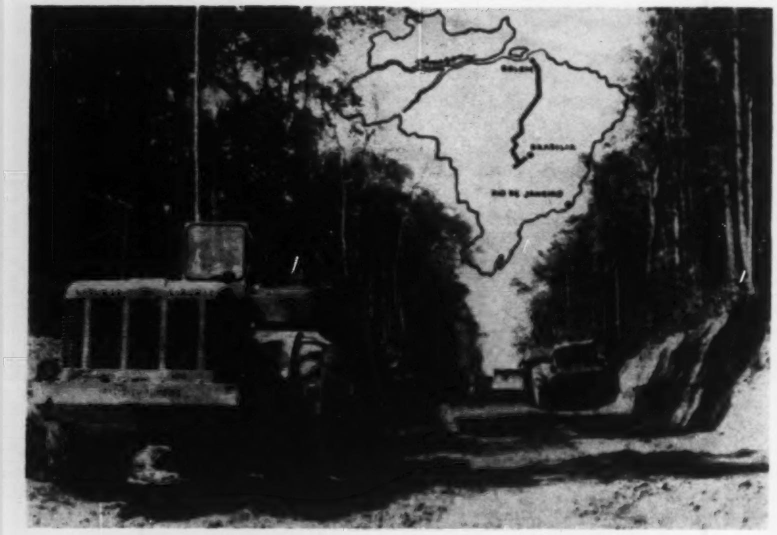
At a special awards luncheon, certificates of honorary membership in the Institute were presented to engineers representing many branches of the profession. ASCE members receiving these certificates were Richard L. Hearn, of Queenston, Ontario, former general manager, chief engineer, and chairman of the Hydro-Electric Power Commission of Ontario; Otto Holden, of Willowdale, Ontario, chief engineer of the Hydro-Electric Power Commission of Ontario; and John N. Finlayson, a consulting engineer of Vancouver and former president of the Institute. Honorary membership in the EIC is awarded for "eminence in engineering and the kindred sciences."

Julian C. Smith Medals, which are given for "achievement in the development of Canada," were presented to the Hon. Clarence D. Howe, F. ASCE, consulting engineer of Montreal and a former Cabinet Minister in the Canadian Government, and to Hugh Young, deputy minister of the Dominion Department of Public Works.

At the banquet concluding the three-day program, George M. Dick, of Sherbrooke, was inducted into the presidency of the EIC. Mr. Dick is chief engineer of the Canadian Ingersoll-Rand Company, Ltd.

ASCE was represented at the meeting by President Frank A. Marston, who received a certificate of honorary citizenship.

George M. Dick (left) new president of the Engineering Institute of Canada, receives gavel from retiring President J. J. Hanna at banquet closing the three-day program.



Men and Machines Push Trans-Brazil Highway

To build the newly opened roadbed of the 1,400-mile Trans-Brazilian Highway between Belem and the new capital of Brazilia, 5,000 construction workers inched through the world's most impenetrable jungle seven days a week, 24 hours a day, for three years. Equipment ranged from crude machetes to giant earthmoving machines. At this stage the 1,400-mile roadway is passable for vehicles in normal weather. The job of bringing it to finished grade and hard surfacing is expected to take another three years. Even when the road has been surfaced, continuous maintenance will be necessary to keep the fast-growing jungle from closing in. It is said that the 72-ft-wide jungle road will be to the development of Brazil what the first transcontinental railroad was to the United States. Photo courtesy Allis-Chalmers.

City Within a City—Portland, Ore.

Portland's changing skyline is dominated by the sprawling Lloyd Center, a $30-million downtown retail and business center, scheduled to open August 1 as the largest shopping center in the nation. The completed project will contain 1,200,000 sq ft of rentable space for 100 retail stores, business houses, offices, a 300-room hotel, recreational and sports facilities, and a medical center. Free parking for 8,000 cars will be provided. Enclosed pedestrian malls free from automobile traffic will help make shopping easy. The malls will be landscaped with native shrubs and seasonal flowers, and there will be benches for the footsore. The Lloyd Corporation of Portland is developing the project. Key planners include John Graham and Co., architects and engineers of Seattle and New York, and Harland Bartholomew and Associates, traffic consultants of St. Louis, Mo.

Boston Sewer Tunnel Is Holed Through

Completion of tunnel excavation for Section 5 of the South Charles Relief Sewer, Boston, was celebrated by the contractors—MacLean-Grove & Company, of New York City—with a traditional holing through party on June 4. The work, done for the Metropolitan District Commission, consists of 8,000 ft of 9-ft-dia tunnel, ranging in depth from 30 to 35 ft. The tunnel has a primary lining of plates and a secondary lining of reinforced concrete. Two shields and compressed air were used to drive the tunnel simultaneously, from opposite directions, through materials ranging from stiff clay to gravel. Almost one-third of the tunnel is curved.

Construction was under the supervision of John F. Johnston, project manager; Frederick Sager, tunnel superintendent; and Henry R. Tiedemann, project engineer. Frederick W. Gow, M. ASCE, is chief engineer of the Construction Division of the Metropolitan District Commission, and Donald K. Sampson was resident engineer on the project.

Electrodialysis Plant For Making Fresh Water

A prototype of the nation's first high-capacity single-unit electrodialysis plant for removing salt from inland brackish waters such as are found in West Texas has been built by Texas Electric Service Company in Fort Worth. At the recent summer annual meeting of the American Society of Mechanical Engineers in Dallas, H. R. Drew, director of research for the company, reported that the 40-ft-long laboratory unit is capable of treating moderately saline water, making it suitable for human, industrial and agricultural use. It has six product streams that can produce about 30,000 gal of potable water a day. It was designed as a model for a plant capable of treating enough water to supply the needs of a city of about 10,000 people. Additional product streams may be added merely by enlarging the original unit.

"We know that our present design is far from the ultimate," Mr. Drew declared. "In fact, we have learned enough in building it to warrant starting all over again with an immensely improved version. Nevertheless, it does represent the first attempt in this country to build a prototype for a high-capacity single cell (unit) plant. As such we feel that it is a success. . . . We feel that large-scale electrodialysis plants of the future, operating at high load factors, will be capable of producing potable water from moderately salty waters for costs on the order of 30 to 50 cents per 1,000 gallons. This does not include the cost of obtaining the salt water or of filtering or other pretreatment.

The first installation in this country of an electrodialysis plant for the supply of municipal water, a small installation at Coalinga, Calif., produces fresh water for $1.45 per 1,000 gal. Although high, this cost represents a considerable savings for Coalinga, which had been hauling in its drinking water by railroad tank car at much greater cost.

May Steel Output Down from April

The May steel output of 8,832,000 tons trailed the April production of 9,777,857 tons and was considerably below the 11,600,581 tons made in May 1959. The total output of 53,350,750 tons for the first five months of 1960 was 19,819 tons lower than in the corresponding period of 1959 when the production was a record 53,370,650 tons. These estimates were made by the American Iron and Steel Institute in its monthly preliminary report.

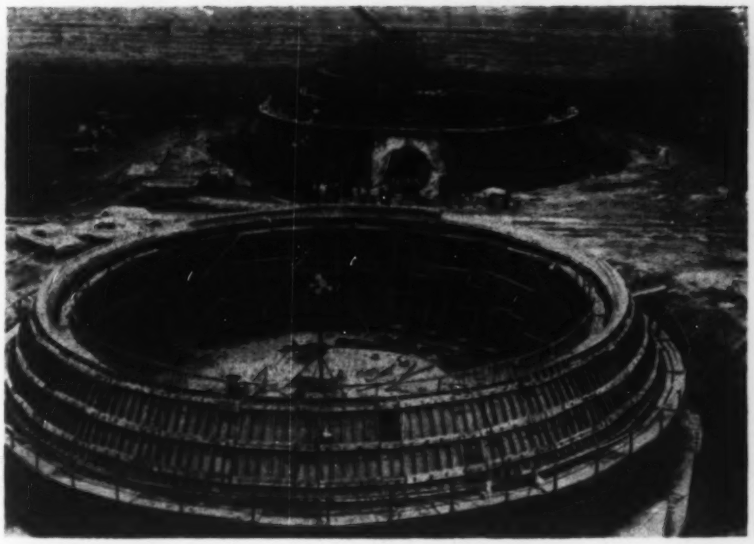
Based on the January 1, 1960, capacity rating of 148,570,970 net tons of raw steel annually, the steelmaking facilities of the nation were utilized at an average of 70 percent of capacity during May 1960, against 80.1 percent of capacity during April. The average for the first five months of 1960 was 86.2 percent of capacity.

First Concrete for Glen Canyon Dam

First concrete was placed deep in the foundations of Glen Canyon Dam, on June 17, when Secretary of the Interior, Fred A. Seaton tripped the mechanism on a 12-cu yd concrete bucket. The ceremonies initiating construction of the major single feature of the work were attended by government notables headed by Secretary Seaton and Paul Fannin, Governor of Arizona. Nearly 420,000 buckets of concrete will be placed in the next two and a half years, as the massive dam rises block by block to a height of 700 ft. The finished dam will contain 5,000,000 cu yd of concrete—enough to build a four-lane highway from Chicago to Phoenix.

Built by the Bureau of Reclamation as a sister structure to Hoover Dam, Glen Canyon Dam will join the latter structure in regulating the river's flow to provide multiple-purpose benefits. It is located on the Colorado River in northern Arizona 370 miles upstream from Hoover Dam. The project was authorized in 1956, and is scheduled for completion in 1964.

Like all large Bureau of Reclamation dams, Glen Canyon is being built by private contracts. The prime contract, totaling $107,955,122 and covering construction of the dam and powerhouse, was awarded to the Merritt-Chapman & Scott Corporation, of New York City, in April 1957. It is the largest single contract ever let by the Bureau.



Control Structures for ICBM Project in South Dakota

These igloo-like structures will house the power and control centers for each of three complexes in the $28.5 million Titan Intercontinental Ballistic Missile Project under construction on the prairie near Rapid City, S. Dak. In the background a forest of steel scaffolding rises from the 120-ft powerhouse as workmen prepare it for a new set of forms. The powerhouse will house generators, air filtration systems, water supplies, and numerous other facilities. The control center will hold the launching console with its delicate electronic instruments. The completed domes will be buried 17 ft below the prairie floor, visible above the open cut. In addition to the two giant igloos, the typical subsurface complex contains three 160-ft missile silos, each with its launcher and adjoining propellant and equipment terminals, and two small silos for retractable antennae. Access tunnels will link the several installations. The project will require the excavation and replacing of 2,000,000 cu yd of dirt. The designers are Daniel, Mann, Johnson, & Mendenhall & Associates, of Los Angeles. C. H. Leavell and Co., of El Paso, Tex., is the prime contractor.

Chicago to Extend Lake Michigan Pier

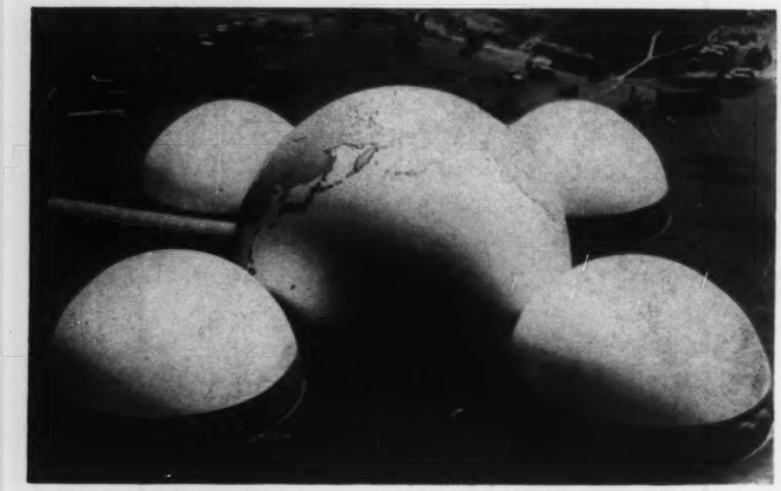
The Chicago Department of Public Works has awarded a $1,875,000 contract to Raymond International Inc., of New York, for construction of a 1,250-ft extension of its Navy Pier facilities in Lake Michigan. The new pier will be of modern prestressed concrete design, permitting construction in only six months. The 96-ft-wide deck of precast prestressed concrete planks will carry two railroad tracks. An unusual feature of the project will be the use of prestressed concrete cylinder piles to support the deck. These piles are said to be able to support unusually large loads for their size and weight.

The pier is being built to handle the increased shipping resulting from the opening of the St. Lawrence Seaway. It was designed by the Bureau of Engineering of the Department of Public Works, which is headed by Dick Van Gorp, F. ASCE, chief engineer. Arthur Fertell will be project manager for Raymond International.

Colombia Receives Loan to Expand Electric Facilities

Colombia will expand its electric power facilities in the Cauca Valley region with a $25,000,000 loan from the International Bank for Reconstruction and Development (the World Bank). The generating capacity of the region will be nearly doubled through the immediate addition of 93,000 kw of new capacity. Included in the expansion program are a 33,000-kw steam unit; a hydroelectric power plant on the Calima River with an ultimate capacity of 130,000 kw; and enlargement of transmission facilities. The loan will cover the initial stages of the program, which is estimated at $37,000,000.

The consulting engineers for the project are an association of Gibbs & Hill, Inc., Tippetts-Abbett-McCarthy-Stratton (both of New York), and Olarte, Ospina, Arias & Payan, Ltd., of Bogota, Colombia. The three firms performed the preliminary engineering work, and are currently preparing bid plans and specifications for the project.



World's Largest Air-Supported Structure

Massive size of air-supported structure, now in use as a missile maintenance shelter at Andrews Air Force Base near Washington, D. C., is revealed in this air photo. Made from nylon coated with Geon vinyl, a product of the B. F. Goodrich Chemical Company, the huge structure is supported by air at a pressure of 1/10 psi generated by low-pressure high-volume blowers. It is 150 ft in diameter and the height of a nine-story building. Four smaller domes, each 50 ft high, are connected to the main structure. Heavy equipment can be moved in and out of the structure through 100-ft-long pressure locks. Anchors hold the shelter in place.

Alaskans Break Ground for Engineering Laboratory

University of Alaska engineering faculty and alumni break ground for the first stage of a new engineering laboratory building on the campus at College, Alaska. Wielding the shovel is Charles Sargent, M. ASCE, acting dean of faculty. Photo shows (left to right) three students: H. Woodrow Johansen, M. ASCE, district engineer for the U. S. Bureau of Public Roads; John Mehler, university librarian; Ben Atkinson, university engineer; Robert Hanson, engineer for the Burgess Construction Co. (the contractor on the job); George Knight, A.M. ASCE, assistant professor of civil engineering; Dr. Robert R. Wiegman, vice president of the university; Dr. E. F. Rice, M. ASCE, acting head of the civil engineering department; Dean Sargent; Dr. Ernest N. Patty, president of the university; Douglas Huber, president of the Alaska Section of the AIME; and Donald MacDonald III, an alumnus and son of a pioneer Alaskan engineer. The building of reinforced concrete with curtain wall construction will house laboratories, engineering classrooms, and faculty offices. The first stage will cost $708,000, and the second stage around $900,000.

Atlantic Seaway Plans Disputed

Eastern Canada is sharply divided on the subject of the long-proposed 16-mile canal that would separate New Brunswick and Nova Scotia and form an extension of the St. Lawrence Seaway. The so-called Atlantic Seaway—first proposed by France almost 275 years ago—would involve digging a canal through the Isthmus of Chignecto to reduce transportation costs between the Atlantic seaboard and the interior of the continent.

What gives urgency to the plan is that, with the opening of the St. Lawrence Seaway, ocean-going vessels can sail into the Great Lakes with their cargoes. If the proposed 16-mile canal were built, vessels moving to or from the south would no longer have to make the long trip round the peninsula of Nova Scotia before entering the Gulf of St. Lawrence. The voyage up the Bay of Fundy and through the proposed canal into the St. Lawrence would be 500 miles shorter and would result in lower transportation costs.

Pressure for the canal comes mainly from New Brunswick, with some support from western Nova Scotia. Eastern Nova Scotia, and especially the port of Halifax, is hostile to the proposal because it fears loss of port business. A study recently commissioned by the Chignecto Canal Company indicates that a one-lock canal 16 miles long, 300 ft wide, and 35 ft deep would cost $90,000,000. The Canadian government is expected to assume the cost, which would be amortized over a 50-year period.

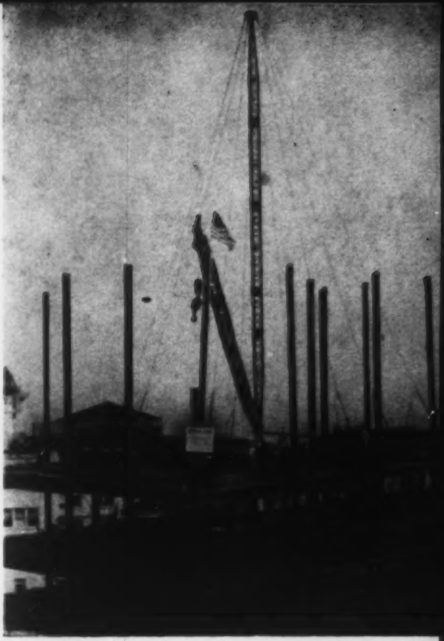
Army Uses Steam to Drill Wells in Arctic

As a solution to the problem of water supply in the Arctic, the Army Corps of Engineers has developed a method of using steam to drill water wells in the Greenland ice cap. The method, which opens the way to expanded military operations in a vital area, utilizes the Vapor Heating Corporation's generator, called the "Upgrader Senior."

Using steam, a 40-in.-dia shaft is drilled to a depth of 150 ft until a homogeneous ice structure is reached. There the steam bit is held stationary while it melts a reservoir up to 50 ft in diameter, from which water is pumped into the camp's supply system. As the water level falls, more steam is used to drill deeper into the ice cap.

Developed by the Army's Research and Development Laboratories at Fort Belvoir, Va., the method will provide water for 200 soldiers and scientists connected with the Corps of Engineers, who will spend the coming winter in a city beneath the Greenland ice cap.

Tallest Welded Building in East Topped Out



Western Electric Company's new office building at Broadway and Fulton Street, Manhattan, is topped out in traditional flag-raising ceremonies. The $20,000,000 31-story building, the tallest all-welded structure in the east, was fabricated and erected by the Dreier Structural Steel Company, Inc., Long Island City. Welded connections were chosen for speed, economy and quiet erection. Architects are Shreve, Lamb & Harmon Associates; the consulting engineers, Purdy & Henderson; and the general contractors, the George A. Fuller Company. The Dreier Company is also fabricating the steel for the United Engineering Center.

EXAM GEMS

by Reggie Strashn

R. ROBINSON ROWE, F. ASCE

EXAMGEM No. 12 was prepared for a small class of hopefuls at a time when Nevada aspirants preferred trying in California first and then seeking reciprocity at home. So far as I know, only one man solved it, and here's how he claims he did it.

"We had to pump 900 gpm (that's 2 cfs) thru an 8-in. steel pipe for which Kutter's $n = 0.013$. We were allowed tables, which gave the hydraulic grade $s = 0.0328$.

"The line ran from a mine sump up a slope of 300 ft vertical to 400 ft horizontal to a summit, then down an adit 50-ft vertical in 600-ft horizontal. The adit grade was $s' = 0.0833$, so if we pumped to the summit, the water would run on to the portal by gravity.

"All I had to do was pump to the summit, lifting 300 ft and overcoming friction in 500 ft of pipe (not 400; I saw that trap). The friction head was 500 (0.0328) = 16.4 ft; total head 316.4. So the lift power was

$$P = QH/8.8 = 2\,316.4/8.8 = 72 \text{ hp}$$

"I usually get the efficiency reversed, but I remembered that input must be greater than output, so with 80 percent efficiency, the input was 90 hp. But they wanted the motor rating in kw, so my final step was

$P_m = 90\ (0.746) = 67.1$ kw'."

That was a pretty good solution. Of course he forgot to add the pipe diameter and velocity head to the energy required at the summit, Fig. 1 (*a*), but the extra 1.17 ft of lift only adds 0.3 kw to the answer.

However, a perfect answer has to be more logical in disposing of the 600-ft line. Suppose it was trapped at C and primed with an air-pump at B; would it siphon, reducing the gross lift to 287.32 ft and power to 61 kw? Fig. 1 (*b*) shows the vacuum head at B would be 30.25 ft; is that too much?

Fortunately you were allowed to bring a lot of books in case you had forgotten that the atmosphere at El. 5000 will only support a 29.45-ft column of water, and that vapor will lock the siphon if you try to lift much more than 20 ft. So you propose to operate on Line (c) with an air-pump at B and a trap at some point D, using a 63.2-kw motor.

In recapitulation, Line (c), with a 20-ft siphon is the best answer; Line (b) with a full siphon won't work and is wrong; Line (a) is a good answer and can be made perfect by stating an assumption that lack of an air-pump and trap in the problem set-up precluded consideration of siphonage. Necessity for such statements should not be overlooked by registration candidates.

Those who attended the Reno Convention learned something of the problem of mine drainage on the Comstock Lode at Virginia City from the story of the Savage Sump and the trip to the Sutro Drain Tunnel. Many siphons were used and many failed with millions at stake, so siphon problems are quite appropriate to Western exams.

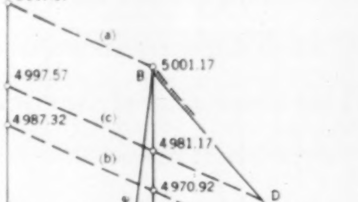


Fig. 1. Energy lines for 3 solutions: (a) free flow; (b) full siphon; and (c) 20-ft siphon.

Branch-pipe problems are even more common. For practice, let's try one of the first, used in Michigan in 1933.

EXAMGEN No. 13

Two reservoirs 20 miles apart have a difference of 200 ft in levels of their surfaces. They are connected as follows: a new 36-in. reinforced concrete pipe leads out of the higher reservoir and runs 10 miles to a wye; from the wye two pipes run to the lower reservoir, one a 24-in. reinforced concrete 10 miles long, the other a 30-in. reinforced concrete 15 miles long. What is the discharge of each pipe?

Bureau of Standards to Relocate in Maryland

Plans for relocating the laboratories of the National Bureau of Standards at Gaithersburg, Md., call for the start of construction on the first three units involved within the next year. Congress recently appropriated $23.5 million to finance this initial phase in the relocation of the Bureau. The first phase will include the construction of an Engineering Mechanics Laboratory, a Radiation Physics Laboratory, and the power plant. The two laboratory buildings were given priority among the twenty buildings to be constructed in the relocation program because of their importance in national science activities.

The General Services Administration, which is responsible for the construction program, will award the first construction contracts toward the end of 1960, and completion of the first buildings is expected to take about two years.

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DECEASED

Allan Gordon Cherry (A.M. '23; M. '59), age 68, since 1933 construction engineer for the M. H. Treadwell Company, Inc., of New York, died recently in that city. From 1912 to 1933 Mr. Cherry was, respectively, structural designer and hydraulic engineer on the Conowingo (Md.) Project and hydraulic and project engineer on the Osage (Mo.) Project, for the Stone & Webster Engineering Corporation, of Boston, Mass. During his long tenure with the Treadwell Company he had worked on the lock design of the Chickamauga and Guntersville dams of the TVA system and had been construction engineer on Waterside Station No. 2 and the Sherman Creek Station for the Consolidated Edison Company of New York.

Fred W. Claflin (A.M. '11; M. '59), age 80, for nearly 40 years consulting engineer of Johnstown, Pa., died there recently. His professional accomplishments included five years as resident engineer and superintendent of construction of a $65,000,000 plant enlargement in Jamshedpur, India, for the Tata Iron & Steel Company; seven years as resident engineer and superintendent of construction of the Quemahoning Dam; and several years as supervisor of construction on the North Fork Dam and Reservoir for the Johnstown Water Company.

Samuel M. Collier (M. '52; F. '59), age 61, consulting engineer of New York City, died recently in Detroit, Mich. Mr. Collier had been employed by Sanderson & Porter as designing engineer on the Altoona Dam and Reservoir Project and by Canada Dry, Inc., for nine years as chief structural engineer.

J. H. Glanding (A.M. '36; M. '59), age 57, a civil engineer with the Physical Plant Planning Division of the University of Pennsylvania, died recently in Philadelphia. He formerly was with the Radio Corporation of America's International Division, during which time he spent 18 months as resident engineer on a new factory in Sao Paulo, Brazil.

Parker R. Grimes (A.M. '53; M. '59), age 50, chief of the planning branch power section of the Walla Walla Engineer District of the Corps of Engineers, died on May 16 in Walla Walla, Wash. He was widely known for his power studies for John Day and four lower Snake River dams currently in various phases of construction. At the time of his death, Mr. Grimes had served the District for ten years. Previously he had been with the Federal Power Commission in San Francisco.

David Harold Hancock (A.M. '59), age 37, sales engineer for Armco Drainage and Metal Products, died recently in Greenville, N. C. A 1943 civil engineering graduate of North Carolina State College, Mr. Hancock had served in the North Carolina Highway Commission in various capacities before joining Armco in 1955.

Burton R. Ingalls (J.M. '53; A.M. '59), age 36, since 1956 assistant supervisor in charge of surveys and maps for the Washington State Department of Natural Resources, died in Olympia, Wash., on May 31. Mr. Ingalls received a degree in engineering from the University of Washington in 1952, and shortly thereafter joined the Engineering Department of Bellingham, Wash., as associated city engineer.

Schuyler Brush Knox (M. '09; F. '59), age 87, former manager of the Fort Pitt Bridge Works, New York City, died there recently. A career employee of the firm, Mr. Knox was in charge of its New York office, directing the activities of the eastern territory as manager and executive from 1899 until his retirement in 1939.

Adolf H. Koebig, Jr. (A.M. '32; M. '59), age 73, chairman of the board of directors and president of Koebig and Koebig, of Los Angeles, Calif., died in Berkeley, Calif., on April 30. A pioneer in modern sewage treatment and recognized authority in the design of water works, irrigation systems, and hydroelectric plants, Mr. Koebig had been a consulting engineer in California and the western United States for 50 years.

James K. K. Look (A.M. '59), age 30, Honolulu engineer assigned by the Corps of Engineers to gather first-hand information on the seismic wave that struck the Hawaiian Islands two months ago, died in the catastrophe at Hilo on May 23. He was project leader responsible for the first design of a tsunami wall to protect Hilo from future seismic waves. Although Mr. Look had received his civil engineering degree from the University of Hawaii only last June, he had worked for the Corps for years. The wall when completed may be named for Mr. Look.

Gabriel E. F. Lund (M. '31; F. '59), age 74, project manager with Michael Baker, Jr., Inc., in Guayagiul, Ecuador, died on May 2 in Fort Lauderdale, Fla. Much of Mr. Lund's professional life had been spent on engineering projects in Latin America. He had been field engineer and chief civil engineer on con-

(Continued on page 98)

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Deceased

(Continued from page 96)

struction of a sugar mill and industrial town in Cayo Mambi, Cuba; superintendent of construction of an Army-Navy air and seaplane base at Belem, Brazil; engineer consultant to the Colombian government on transportation and highway construction for the Institute of Inter-American Affairs; and project division engineer on construction of a highway in Cochabamba, Bolivia, for the Knappen, Tippetts, Abbett Engineering Company.

George H. Maurice (M. '10; F. '59), age 88, public official, engineer and historian, died recently in Eagle Springs, N. C. In the years between 1893, the year of his graduation from Lehigh University, and the early 1940's Mr. Maurice was active in designing and building bridges and railroads and supervising municipal engineering programs in the East and South. As a historian, he was author of "Daniel Boone in North Carolina" and had charge of restoration work at the pre-Revolutionary Alston House, now a State historic site, where plans are being made to erect a bronze tablet as a memorial to him.

Frank Thomas Miller (M. '23; F. '59), age 75, specialist in railroad engineering, died recently in Greensboro, N. C. Mr. Miller was a consulting engineer in Greensboro from 1920 until his death. His earlier experience included 15 years with the Southern Railway Company, which he served in various capacities from rodman to resident and office engineer.

Anthony Thomas Moran (M. '30; F. '59), age 80, since the early 1940's associate engineer with the Corps of Engineers in New York City, died there recently. Prior to joining the Corps, Mr. Moran served as superintendent of the Dregnon Company for the construction of the Steinway tunnel at 42 street and the East River, New York; as subcontractor on the New York Barge Canal; and as contractor for the New York State Highway Department. He was also borough engineer of Shenandoah, Pa.

James Moreland (M. '39; F. '59), age 69, former representative of the International Bank of Reconstruction and Development, in Bogota, Colombia, died recently in Nashville, Tenn. Mr. Moreland served as a lieutenant colonel during World War II, and in recent years had been with the Corps of Engineers. He was with the Tennessee Valley Authority in Chattanooga for eight years.

John H. Obermuller (A.M. '29; M. '59), age 74, retired assistant planning engineer for the California State Division of Highways, died recently in Sacramento, Calif. At the time of his retirement in 1955 Mr. Obermuller had served with the Division of Highways for 27 years. Earlier he had been assistant city engineer for San Francisco on the Hetch Hetchy Project for two years and on the staff of the Bureau of Public Roads for ten years.

George William Prichard (M. '49; F. '59), age 52, owner of Prichard Company, Inc., died recently in Kansas City, Mo. Mr. Prichard founded his company in 1952 after serving for nine years as field engineer with the Missouri Highway Department in Jefferson City, and for six years as civil engineer with Black and Veatch Consulting Engineers, of Kansas City. From 1940 until 1946 he served with the armed forces, receiving many decorations for his services.

Renville Stevens Rankin (M. '44; F. '59), age 68, retired sanitary engineering executive for Dorr-Oliver, Inc., of Stamford, Conn., died on June 6 in Stamford. Following his retirement from Dorr-Oliver in 1956 as director of sanitary technical engineering, he continued as consultant on sanitary engineering practices to the firm and its subsidiary companies abroad. For the past two years Mr. Rankin had served the American Sanitary Engineering Intersociety Board—certifying agency for the American Academy of Sanitary Engineers—as secretary-treasurer. Author of numerous papers on biofiltration and other sludge-digestion subjects, he was recipient of the 1948 Kenneth Allen Memorial Award of the New York Sewage Works Association for his writings on *Digester-Capacity Requirements.*

Clarence W. Raynor (M. '13; F. '59), age 84, from 1921 until his retirement in 1950 structural engineer with the Bureau of Buildings of Portland, Ore., died there recently. His previous professional experience was as partner in the Denver firm of Western Engineering Company; as chief engineer of the C. G. Sheely Contracting Company, Denver; and as chief engineer of the Coast Bridge Company, Portland.

Kazys Rimkus (M. '52; F. '59), age 57, senior highway engineer for the Delaware State Highway Department at Dover, Del., died recently. A native of Lithuania, Mr. Rimkus was division and chief engineer for waterways in that country from 1936 until 1944. He came to the United States in 1949 and joined the Bridge Division of the Delaware State Highway Department.

Walter Edward Sanford (A.M. '09; M. '59), age 79, retired hydraulic engineer of the Commonwealth and Southern Corporation, died recently in Hamden, Conn. During nearly 20 years of service

(Continued on page 100)

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(Continued from page 98)

with Commonwealth and Southern, Mr. Sanford had charge of power studies in connection with hydro plants in Alabama, Georgia and Tennessee, in addition to furnishing annual records of daily flow to the U.S. Geological Survey for publication in *Water Supply Papers.*

Walter Luke Seigenthaler (A.M. '57; M. '59), age 34, sales engineer for Armco Drainage and Metal Products, Inc., of Atlanta, Ga., died recently. A 1949 graduate of Vanderbilt University, Mr. Seigenthaler was office engineer with the Army Corps of Engineers, Nashville District, from 1952 until he joined Armco in 1957.

Oscar A. Seward, Jr. (M. '23; F. '59), age 73, who retired in 1951 as senior resident engineer for the Texas State Highway Department after 30 years of service, died recently in Brenham, Tex. He was the first engineer to put rock, grass or concrete retards in hillside ditches to prevent washes and he built the first super-elevated and widened curve on a state highway. On leave of absence from the Department during World War II, Colonel Seward was director of supplies and facilities at the Seattle Port of Embarkation. He was awarded several medals for his work in Canada, Alaska and on the Alcan Highway.

LeRoy Sylvester Stanley (A.M. '38; M. '59), age 54, for 30 years on the staff of the Booth & Flinn Company, Pittsburgh, Pa., which he served as project engineer, superintendent of construction, and engineer, died recently in Pittsburgh. During the 1930's he worked with the Tennessee Valley Authority. At the time of his death he was manager of the Pittsburgh office of A. S. Wikstrom, Inc., of Skaneateles, N. Y.

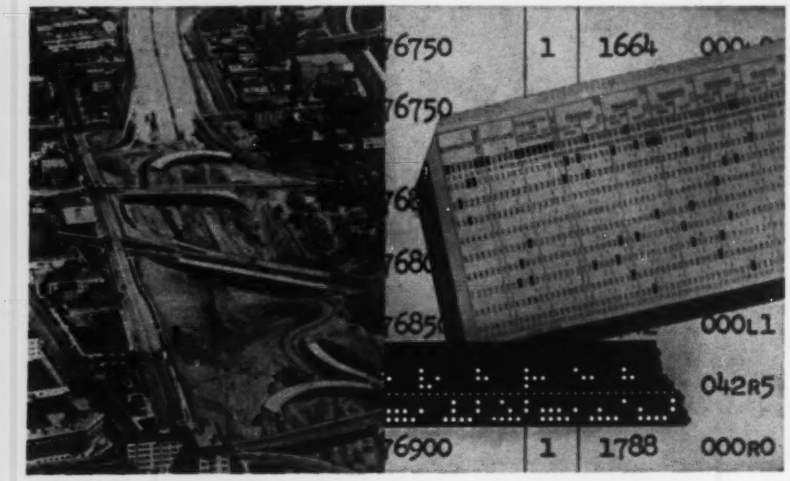
Rufus Carroll Thaxton (M. '37; F. '59), age 72, engineer who retired about ten years ago from the Sacramento regional office of the Bureau of Reclamation, died on May 26 in Sacramento, Calif. Early in his career he was principal assistant engineer in charge of the Flood Prevention Department of the city of San Antonio engaged in the hydraulic study, design, plans and supervision of construction of Olmos Dam and a channel revision through the business section of the city. Mr. Thaxton joined the Bureau in 1932 as associate engineer and had served in Nevada, California and Colorado before retiring.

E. M. Van Norden (M. '06; F. '59), age 84, former assistant to the president of the Consolidated Edison Company of New York, died on June 5 in Amityville, Long Island, N. Y. Mr. Norden joined Con Edison in 1899 as a clerk, eventually becoming mechanical engineer in charge of all its power plant design and construction, and assistant to the utility company's president, a position he held until his retirement in 1943.

John Ellis Van Trees, Jr. (A.M. '26; M. '59), age 65, consulting engineer of Memphis, Tenn., died there recently. For 17 years Mr. Van Trees was a member of the Memphis firm of T. H. Allen (later Allen & Hoshall). He had designed and built a number of drainage and sanitary sewer projects.

Vito Antonio Villani (A.M. '59), age 37, for the past five years engineer with the Vianini Icei International Construction Company of Rome, died recently in Ahwaz, Iran. Earlier, Mr. Villani had been assistant engineer on construction of 65 miles of highway in Lecce, Italy; acting resident engineer for the South Italy Development Board; and soil engineer on construction of an 81-mile highway and allied works. In 1958 he was made chief section engineer with Vianini Icei International.

Ernest Gilbert Waters (A.M. '23; M. '59), age 68, consulting engineer of Park Ridge, Ill., died recently in Chicago, Ill. Mr. Waters had served the California Oregon Power Company, of Medford, as resident engineer on construction of a hydroelectric development; as construction superintendent in charge of three transmission lines and a $3,500,000 hydroelectric development on the Rogue River, Ore., for the Byllesby Engineering and Management Corporation; as vice-president of the American Utilities Service Corporation, Chicago; and over ten years with the Middle West Service Corporation, Chicago.



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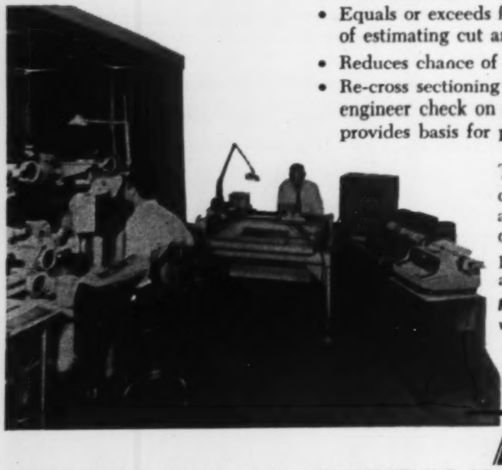

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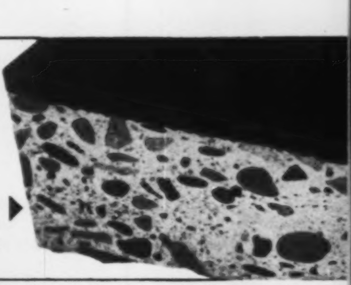

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RECENT BOOKS

(added to the Engineering Societies Library)

Certain Dynamic Problems of the Theory of Shells

This translation from the Russian discusses the vibrations, the dynamic stability, and the resistance-to-earthquakes of thin-walled shells, used primarily as roofs and ceilings in industrial and domestic buildings. Included is an explanation of the hypotheses and most important relations of the Vlasov engineering moment theory of shallow shells. (By O. D. Oniashvili. Published by Morris D. Friedman, Inc., 1383A Washington Street, West Newton 65, Mass., 1959. 178 pp., paper.)

The Dymaxion World of Buckminster Fuller

This book reflects the author's impressions and interpretations of the life and work of Richard Buckminster Fuller,, whose "Dymaxion" idea—getting from any type of structure the maximum net performance per unit of energy input—has created over the past thirty years a steady stream of startling cars, houses, maps, domes and systems of mathematics. Admittedly biased by personal warmth, the author's account is vastly interesting, and nearly 200 pages of superb glossy annotated photographs further illustrate the man and his work. (By Robert W. Marks. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y., 1960. 232 pp., bound. $12.00.)

Engineering Data Processing System Design

Discusses mechanization possibilities in the handling of drawings, engineering parts lists and allied engineering office records as a first step towards electronic data processing systems in the engineering department. Covers the designing, justifying, installing, operating and controlling of a system which includes the use of microfilm and punched cards, and explores the eventual use of electronic equipment. (By Arthur D. Even. D. Van Nostrand Company, Inc., 120 Alexander Street, Princeton, N. J., 1960. 282 pp., bound. $6.50.)

Engineering Thermodynamics

This undergraduate text concentrates on fundamental concepts, the first and second laws, and physical property relationships. It does not attempt to cover all engineering applications of thermodynamics, but illustrates applications of the basic principles presented in the first fourteen chapters in six chapters on fluid flow, fluid machines, gas and vapour power cycles, refrigeration, and binary mixtures. The elements of heat transfer are briefly discussed in the final chapters. Dimensions and units, and a variety of thermodynamic charts and graphs are given in appendices. (By James B. Jones and George A. Hawkins. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1960. 724 pp., bound. $8.50.)

International Association for Bridge and Structural Engineering, Publications 1959

Nineteenth Volume

Various aspects of steel and reinforced concrete construction falling within the Association's province are the subjects of these 15 papers: the theory of trusses, of cylindrical shells, and of orthotropic plates; the plastic theory of structures; buckling loads, deformation of ring girders, boundary conditions; analysis of a skew girder bridge, design of frameworks for specific deflections; etc. Most of the papers are in English; the others have English summaries. (Published in Zurich, Switzerland, 1959. 296 pp., paper. SFr. 40.00.)

Methodes Practiques Pour Le Calcul Des Structures Hyperstatiques

The four methods presented are based on the Mohr theorem, and the two fundamental con-

(Continued on page 104)

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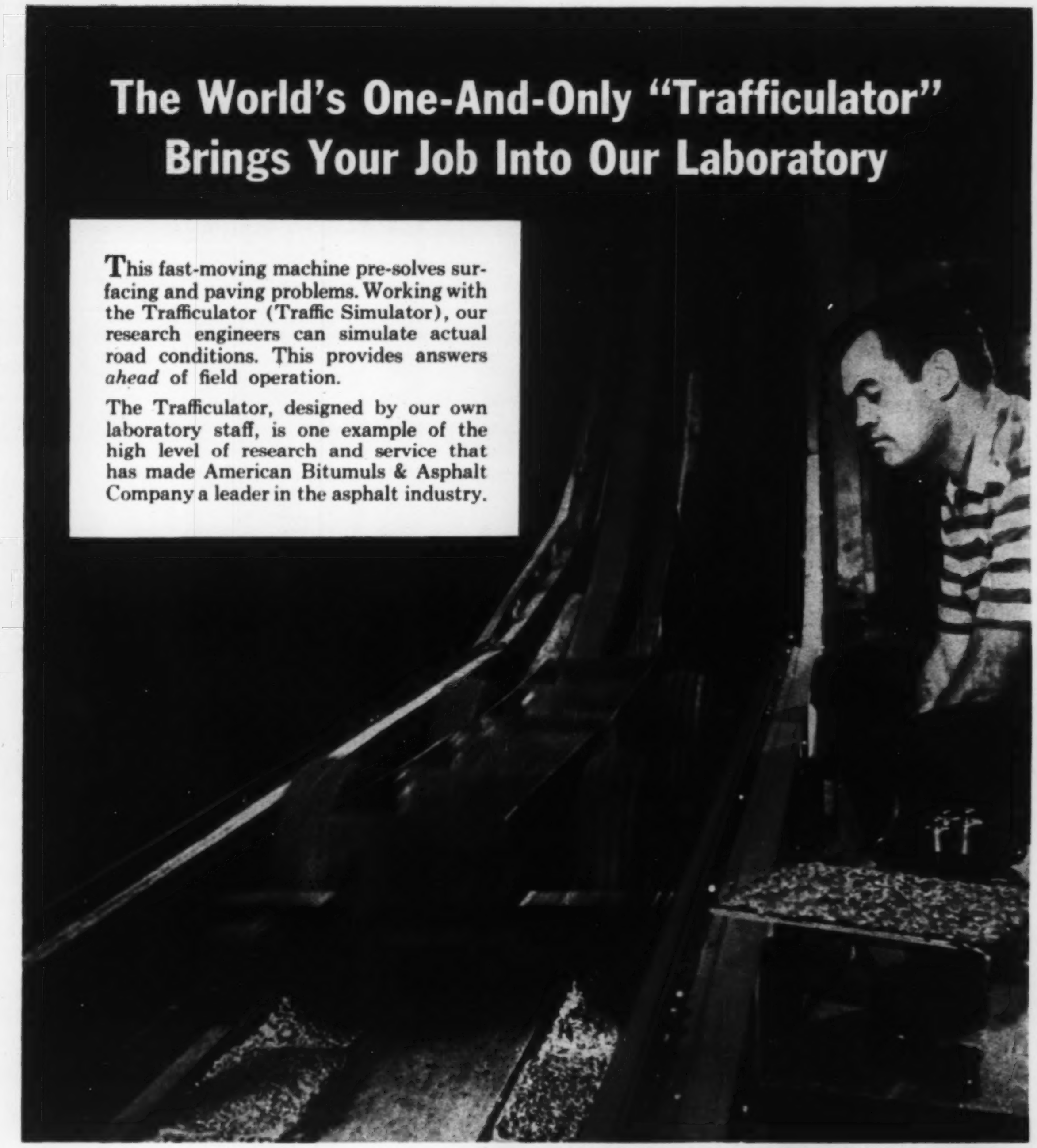

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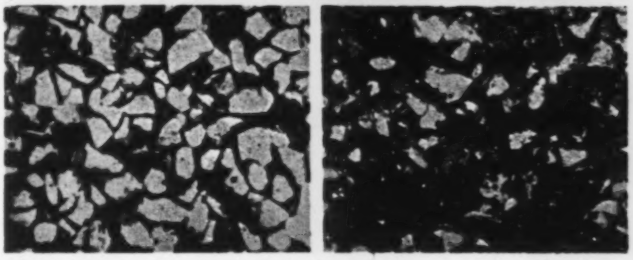

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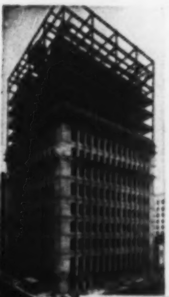
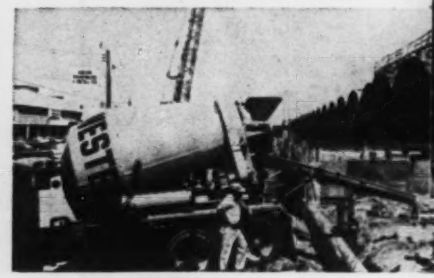


California Bank Office Building, Los Angeles, California



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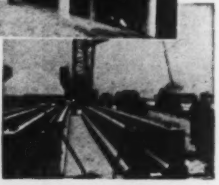

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Recent Books

(Continued from page 102)

cepts, rigidity and the transmission factor. Chapter one discusses the basic theories common to all four methods, and the remaining chapters deal successively with the methods, being the method of fixed points, the Cross method, the Kloucek method and the Kani method. (By F. Touchet. Dunod, Paris, France, 1959. 258 pp., paper. Fr. 2,900.)

Monorails

This brief survey of monorail transportation opens with an historical account, and then discusses types of monorails, cars, track, structures, location and construction, operating characteristics, wayside equipment, and the economics of this means of transportation. There are very useful appendices, including chronological lists of constructed and proposed monorail systems, a tabulation of the dimensions and other characteristics of cars in use, diagrams of rail cross-section and rail supports, and an extensive bibliography. (By Hermann S. D. Botzow, Jr. Simmons-Boardman Publishing Corporation, 30 Church Street, New York 7, N. Y., 1960. 104 pp., bound. $3.95.)

Library Services

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Die Praktischen Berechnungsverfahren Fur Tonnen—Und Trogartige Schalen

Second Edition

A practical design manual for barrel roofs, polygonal shells, and similar structures, which also presents a concise treatment of shell theory based on moment analysis. Brief mention is made of Russian practice in this field. (By Woldemar Tetzlaff. VEB Verlag Technik, Berlin, Germany, 1959. 143 pp., bound. DM 16.00.)

The Scientific Papers of Sir Geoffrey Ingram Taylor

Volume II: Meteorology, Oceanography and Turbulent Flow

The phenomenon of turbulence and its effect provide the main theme of this, the first of three volumes in the series to be devoted mostly to Taylor's work on the mechanics of fluids, but it also contains a wide range of geophysical investigations. Included are papers on diffusion in the atmosphere, formation of fog, tidal friction, tidal oscillations in gulfs, oscillations of the atmosphere, stability of stratified fluids, and convection from sources. (Edited by G. K. Batchelor. Cambridge University Press, Cambridge, Mass., 1960. 515 pp., bound. $14.50.)

Simplified Design of Reinforced Concrete

Second Edition

Prepared in compliance with the recommended unit stresses and design procedure and requirements as given in the ACI Building Code Requirements, a major portion of this book consists of illustrative examples of the design of structural reinforced concrete members. This second edition has several new features, including identification of bar sizes by numbers instead of dimensions, an explanation of the practice of using all straight reinforcing bars in the design of beams, current requirements of web reinforcement, and a chapter on the theory and economic advantages of prestressed concrete. New tables have been added, and all new figures are given. (By Harry Parker. John Wiley & Sons, Inc., 440 Fourth

(Continued on page 110)

The Fabulous Ohio River Development

see story on following three pages . . . . . .

LOUISVILLE, KY.

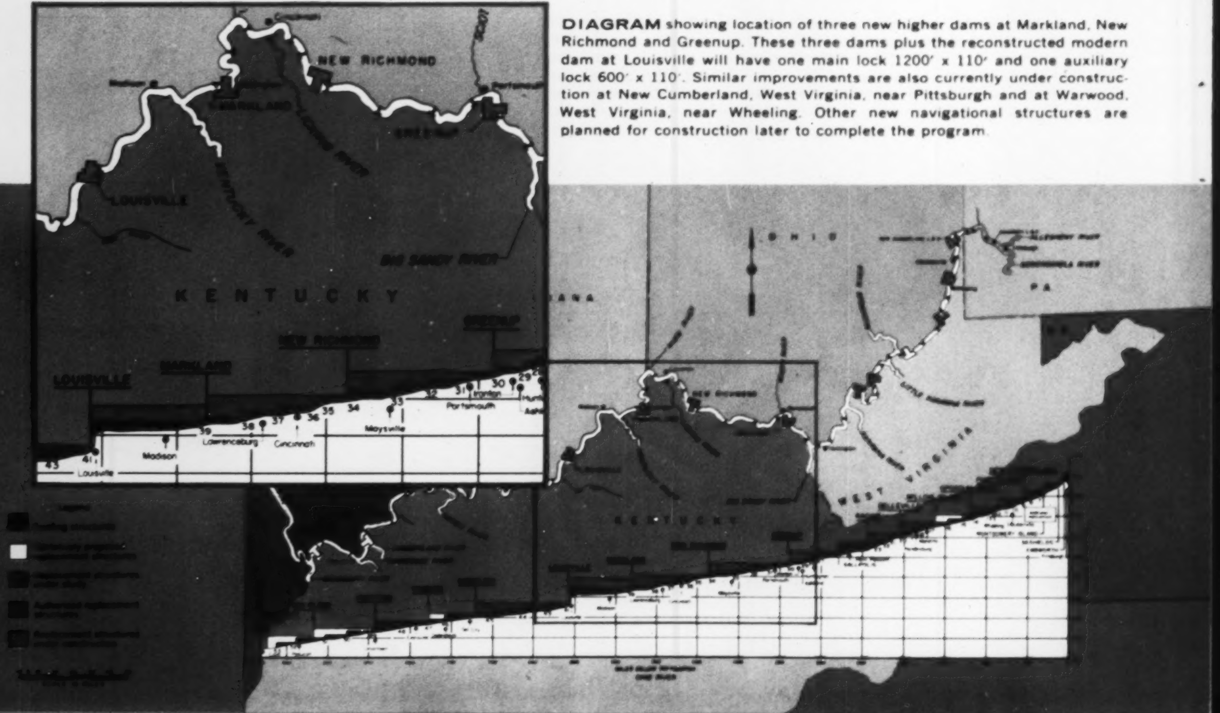
Reconstruction of Lock No. 41 located 607 miles below Pittsburgh This is a complicated job involving four cofferdams: Two main cofferdams, upstream and downstream and two guardwall cofferdams upstream and downstream. A total of 99 cells was constructed using 10,850 tons of USS MP 101 and MP 112 Piling in various lengths from 24 feet to 60 feet. General contractor—Hardaway Contracting Co., Columbus, Ga., under supervision of Louisville District, U. S. Corps of Engineers.

MARKLAND, IND.

Lock and Dam No. 39. Located 531.5 miles below Pittsburgh. Will replace five outmoded navigational facilities. One main lock 1,200 feet long by 110 feet wide and one auxiliary lock 600 feet x 110 feet. Dam gates are 42 feet high by 100 feet long. Lock cofferdam is 3,250 feet long, 50 feet high and contains 8,000 tons of USS Steel Sheet Piling. Lock construction recently completed by Dravo Corporation, Pittsburgh, Pa., under supervision of Louisville District, U. S. Corps of Engineers.

Between Greenup and Louisville . . . Four huge locks and

DIAGRAM showing location of three new higher dams at Markland, New Richmond and Greenup. These three dams plus the reconstructed modern dam at Louisville will have one main lock 1200′ x 110′ and one auxiliary lock 600′ x 110′. Similar improvements are also currently under construction at New Cumberland, West Virginia, near Pittsburgh and at Warwood, West Virginia, near Wheeling. Other new navigational structures are planned for construction later to complete the program.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Ironton
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30
29
O H I O
PA
WEST VIRGINIA
KENTUCKY
Legend

NEW RICHMOND, OHIO

Lock and Dam No. 34. Located 436.2 miles below Pittsburgh. Will replace four older structures. Two locks same size as those at Markland but the dam gates will be only 37 feet high. The lock cofferdam contains 13,465 tons of steel sheet piling and has a total of 56 cells. Maximum length of piling 84 feet. Cofferdam construction by Peter Kiewit, Omaha, Neb.; lock construction by Groves Ventures Company, Minneapolis, Minnesota, under supervision of Huntington, W. Va. District, U. S. Corps of Engineers.

GREENUP, KY.

Lock and Dam No. 30. Located 341 miles below Pittsburgh. Replaces four older structures. Two locks of the same size as Markland. Dam gates will be 37 feet high. The lock structure has been completed by Atkinson-United Companies. A total of 10,194 tons of steel sheet piling was used. Much of this was USS Steel. Lock chamber cofferdam by Dravo Corporation of Pittsburgh, dam and cofferdam by Massman Construction Co., Kansas City, Mo., under supervision of Huntington, W. Va. District, U. S. Corps of Engineers.

dams will replace 14 outmoded structures

USS Steel Sheet Piling is used in the cofferdams

The growing industrial development in the Ohio River Valley has boosted river traffic to more than ten times what it was 30 years ago. In 1957 it was 17 billion ton-miles. Barge tows are now longer and many have to be broken up every time they go through the old 600-foot locks.

To speed traffic, the billion dollar Ohio River navigation replacement and improvement program is now in full swing under the direction of the Ohio River Division Office of the Corps of Engineers at Cincinnati, Ohio.

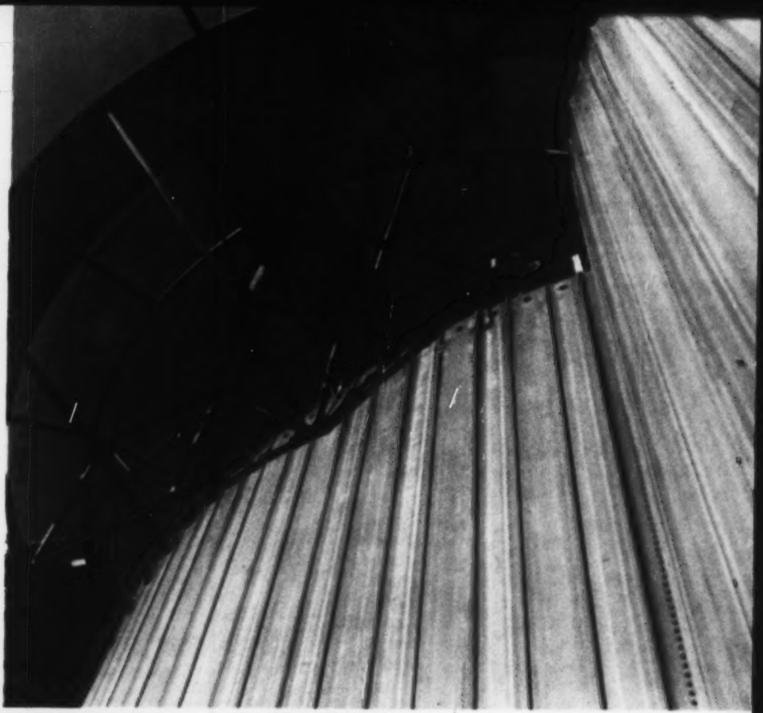
The entire program includes replacement of the present 46 navigational structures with 19 modern facilities. It is estimated that when the program is completed, about 1975, two full days' locking time will be cut off the average running time from Pittsburgh, Pa., where the Ohio River begins, to Cairo, Illinois, where it enters the Mississippi.

In this stretch of river, between Huntington, W. Va., and Louisville, Ky., huge new locks 1200 feet long and 110 feet wide are going in at Greenup, Ky., New Richmond, Ohio, Markland, Ind., and Louisville, Ky. Three new non-navigable dams, built higher to maintain the nine-foot minimum navigable depth, will take the place of 13 old structures in this 300-mile stretch.

One of the first major jobs is to build steel sheet piling cofferdams to dry up the work areas. Thousands of tons of U. S. Steel Sheet Piling are being used in these temporary cofferdams. A large quantity of USS Sheet Piling is also incorporated into the permanent lock structures. U. S. Steel's production capacity insures ready availability of all popular piling sections and makes possible quicker deliveries to each of the job sites. This capacity is advantageously located to provide shipment by various means—in this case by economical water transportation. In addition to steel sheet piling, hundreds of tons of USS Steel H-Piles are being used to support major portions of the structures including the guard and guide walls and in some cases the dam structures.

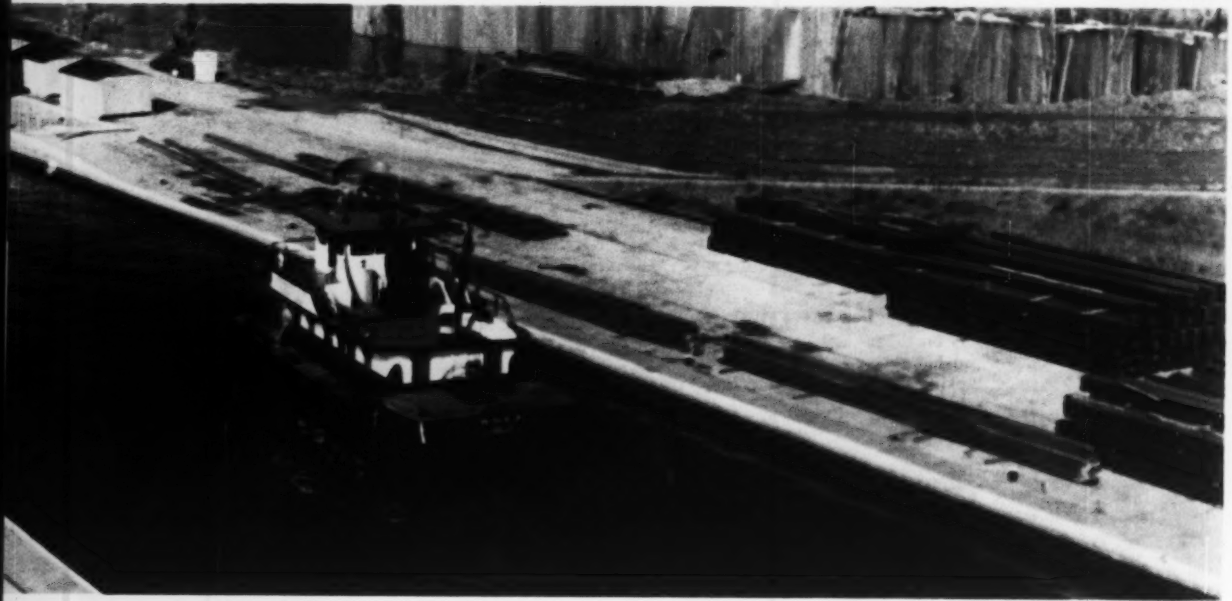
United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Export Company
United States Steel

Additional information on next page . . .



Building a cell at Louisville using a template to assure correct diameter.

USS Steel Sheet Piling stacked and ready for use after delivery by barge to Louisville.



Quick deliveries on USS Steel Piling

U.S. Steel's large production facilities and close attention to customer's needs have made possible "on-time" deliveries even in remote sections of the country. When you want any type of piling in a hurry—Steel Sheet Piling or Steel H-Piles—call the United States Steel office near you. For technical information, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS is a registered trademark

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Export Company

United States Steel

Some Ideas

for your file of practical information on drafting and reproduction . . . from

KEUFFEL & ESSER CO.

Papers, in their special way, are as different as people . . . and choosing the best paper for a specific job can be as difficult as choosing the best *person* for the job. Here at K&E, we try to do the work for you, by painstakingly determining precisely the characteristics required, then refining them to the point of excellence. Here are some good examples:

A New Type Of Typing Paper

Translucent typewriter papers are very popular of late for typed originals from which numerous copies must be made. The savings are considerable when you use translucent originals through diazo reproduction—savings up to 80% in many cases. But most translucent papers used today stand erasure very poorly. Recognizing the inevitability of human error, K&E has perfected a better translucent typewriter paper called TYPEMASTER® (193)—the perfect answer for those whose typing is less than perfect. TYPEMASTER's completely new, *engineered* surface affords outstanding erasability. A thin, unusually tough coating, it readily catches and holds the typewritten image, yet resists penetration of the ink into the paper fibers . . . and therein lies the secret of good erasability. A number of skeptics who tested the new TYPEMASTER sheets have now discarded all others. Skeptical or not — may we suggest you try it.

Tracing Pads "To Travel"

Brilliant ideas often occur at random moments. For that reason, engineers on the move usually keep a tracing pad handy. But pads with soft, chipboard backing are of little use without a desk under them. That's why all K&E tracing pads are backed with sturdy bookbinder's board — the same tough board found in any high-priced, permanently-bound library volume. Wherever you are you're assured desk-firm support with a K&E pad. Another plus — the sheets are bound in by a gummed edge for neat and easy removal. Available in a wide variety of grid patterns and sizes, with plain or imprinted sheets (standard headings), K&E book-bound, gummed-edge tracing pads are perfect workmates for the "portable" professional.

Now You Can "Talk" In Triplicate

Although low-priced canary tissue enjoys wide usage as a so-called "talking paper", we've heard many complaints about its inability to reproduce well in standard copying machines. With this in mind, we present K&E's newest LIGHTWEIGHT SKETCHING TISSUE (185) — designed specifically as a *reproducible* "talking paper." This tissue is ideal for preliminary sketching when you want sharp reproductions from a standard diazo, blueprint or office copying machines. It's a pure bleached sulphate with just enough yellow tint added to afford good contrast for pencil, charcoal or crayon. You'll find K&E LIGHTWEIGHT SKETCHING TISSUE well worth any small price difference.

The Most Pampered Natural Paper In America

For the greatest transparency, the overwhelming choice is K&E ALBANENE® prepared tracing paper. But for ability to stand a lot of abuse on the drawing board and in subsequent processing and handling — many companies prefer to sacrifice some transparency and use a *natural* tracing paper. Here we recommend a truly remarkable K&E product—BANKNOTE T.M. (174L). This thin, flexible, 100% rag tracing paper will weather a double share of abuse. You can actually crumple a sheet of K&E BANKNOTE up into a tight ball . . . then smooth it out to find it almost as good as new for reproduction purposes! The paper makers who produce BANKNOTE for K&E proudly refer to it as America's most pampered tracing paper. No other paper we know receives the same care and attention . . . from initial inspection of the textile bales, through every step of processing, to final shipment. With K&E BANKNOTE, papermaking skills come into play as with no other paper made on this side of the Atlantic — from use of a paper machine that runs a "top jacket" (one of the few still employed), through the artful "wet packing" process, to careful air-drying, super calendering, and rewinding. The result is a sheet of unsurpassed mellowness, yet with unusual stamina and workability.

You can test this quartet of fine papers at your local K&E dealer's . . . or use the coupon below to get samples for private perusal. Do it *today* . . . there's a world of better work at stake.

KEUFFEL & ESSER CO., Dept. CE-7, Hoboken, N. J.

Please send me samples and further information on the following:

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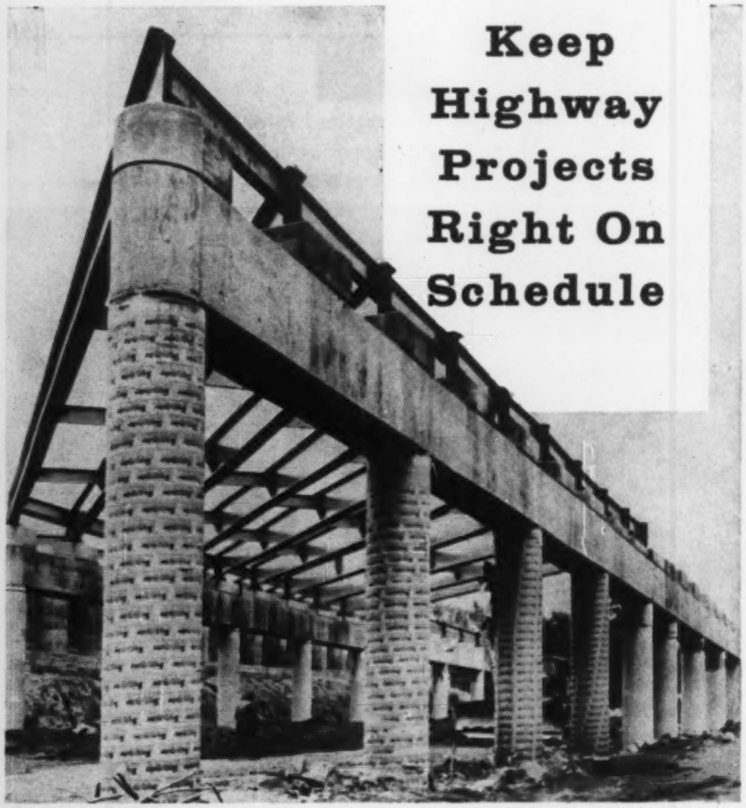
☐ K&E Tracing Pads ☐ K&E BANKNOTE Tracing Paper
☐ K&E LIGHTWEIGHT SKETCHING TISSUE

Name & Title______________________________

Company & Address__________________________

______________________________________ 1539



Keep Highway Projects Right On Schedule

Expressway, Elmsford Section. Westchester County, N.Y.
Contractor: Mount Vernon Contr. Corp.
Chief Engineer: Philip P. Fox.
Designer: Charles H. Sells, Consulting Engineer of New York City.
Photo: Fred & Leo de Wys

Form round concrete piers with

SONOCO
Sonotube®
FIBRE FORMS

Completion schedules are important to every contractor involved in the modern highway improvement program. To speed the construction of bridges and overpasses and maintain their schedules, many alert contractors form round concrete piers with Sonoco SONOTUBE Fibre Forms.

These strong, low-cost forms are easy to handle and place; and, even with their light weight, only minimum bracing is required. Stripping is simple, quick. Stay on schedule with SONOTUBE Fibre Forms — the fastest, most economical forming method for round concrete piers and columns.

In fact, *wherever* round concrete columns are specified . . . in bridges, buildings, or any structure . . . you'll save time, labor, and money by using SONOTUBE Fibre Forms.

Available 2" to 48" I.D., in standard 18' lengths or as required. Can be sawed at the job.

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- BRANTFORD, ONT.
- MEXICO, D.F.

SONOCO
Construction Products
SONOCO PRODUCTS COMPANY

4518

Recent Books

(*Continued from page 104*)

Avenue, New York 16, N. Y., 1960. 303 pp., bound. $6.50.)

Soils and Soil Engineering

Fundamentals of soil engineering are covered extensively but briefly, the first ten chapters discussing the formation, distribution, physical properties, and classification of soils, and characteristics such as permeability, consolidation, shear strength and sub-soil stresses. The final seven chapters consider applications, emphasizing those related to foundations, retaining structures, and slope stability, with limited discussion of compacting, soil stabilization, and chemical grouting. (By R. H. Karol. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1960, 194 pp., bound. $11.65.)

Ventilation des Souterrains en Construction

General material on the characteristics of and conditions in subways under construction, and the overall principles of ventilation are presented, including discussion of fans and vents. Several specific methods of ventilation, based on rigid scientific principles and experimentally proven for a wide variety of tunnel-types are described fully, along with discussion of the materials used, working conditions extant, and the economic aspects of ventilation. (By Paul Expilly. Editions Eyrolles, Paris, France, 1960. 274 pp., bound. 36.55 N.F.)

Wehre

Second Edition

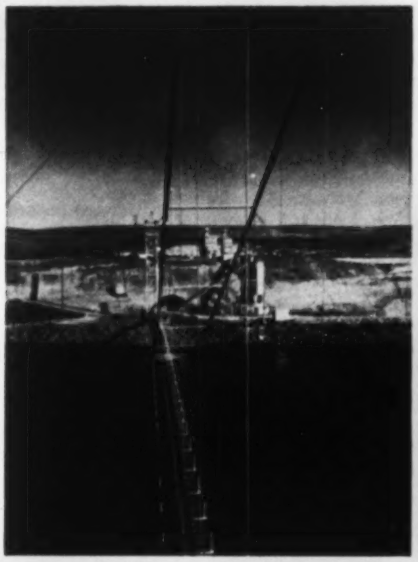
A comprehensive textbook and manual on the design, construction, and use of weirs. All major types are covered: solid weirs, siphon weirs, weirs with many different kinds of movable gates or sections for various purposes. Separate chapters deal with ancillary structures, protection against ice, etc. Over 700 detailed sketches and photographs effectively illustrate all aspects of the book and increase its practical value. (By Heinrich Press. Wilhelm Ernst & Sohn, Berlin, Germany, 1959. 395 pp., bound. 56 DM.)

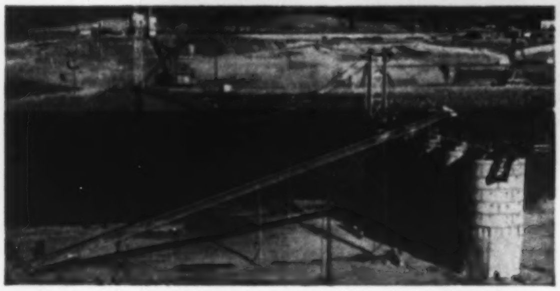
Positions Announced

U. S. Army Corps of Engineers. Seeks qualified personnel for the positions of General Engineer (GS-12, $3,810 per annum), Construction Engineer (GS-12, $3,810 per annum), Construction Management Engineer (GS-12, $3,810 per annum), two Civil Engineering Aids at GS-7 level ($4,980 per annum), Civil Engineering Aid at GS-5 level ($4,040 per annum) and Civil Engineering Aid at GS-4 level ($3,755 per annum). These positions exist at the Area Field Office, Plattsburgh Air Force Base, New York. Interested applicants should contact the Area Engineer, U. S. Army Engineer District, New York, Plattsburgh Area Field Office, Plattsburgh Air Force Base, New York.

Milwaukee County Civil Service Commission. Applications are being accepted for the posts of Civil Engineer I, $455.39 to $535.29 per month; Civil Engineer II, $512.46 to $603.34 per month; and Civil Engineer III, $616.34 to $729.04 per month. Applicants must be over 21 years of age, U. S. citizen and be willing to take a written test and oral interview. For application forms and listing of minimum qualifications write to the Milwaukee County Civil Service Commission, Room 206, Courthouse, Milwaukee 3, Wis.

HOW TO SAVE TIME, MONEY AND MILES WHEN YOU BUILD A DAM





use a Roebling Conveyor Suspension Bridge

The sole purpose of this 1000-foot span, Roebling designed suspension system is to support an aggregate-carrying conveyor. The site is the Ice Harbor Lock and Dam Project at Pasco, Washington, under construction by Guy F. Atkinson Company.

The problem, and it was a large one, was to get the concrete aggregate from the South side of the river to the North side, without having to truck it some 10 miles around. The tremendous amount of concrete needed for the pouring of the dam's locks fully justified the erection of this structure. The savings in time and labor, and the assurance of an uninterrupted flow of material are additional factors that add to its value.

Of course, you don't have to build a dam before a Roebling conveyor *suspension* system can be of value to you. Your needs may be considerably more modest. You may have an in-plant (or "in-and out-plant") materials handling problem. It may be temporary or permanent.

No matter. Roebling designed and constructed suspension systems of all kinds are easing transportation problems for manufacturers and processors with speed, safety and savings. Don't think for a minute that your problem must be of the above magnitude. On the other hand, your needs may be greater. Either way—to carry your conveyor across the yard, or river, or between mountains—a Roebling suspension system can be the most economical answer. For details about your requirements, just ask Roebling's Bridge Division, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation

News of Members

(Continued from page 28)

Elmer B. Calvin is in Bagkok, Thailand as project engineer manager for Charles M. Upham Associates, Inc., consultants to the Royal Thai Highway Department. Mr. Calvin joined the consulting engineering firm in 1956 after retiring as senior resident engineer from the Texas Highway Department at Dallas.

E. R. Needles, a partner in the New York and Kansas City engineering firm of Howard, Needles, Tammen & Bergendoff, and a leading figure in the design and contruction of the Pulaski Skyway, New Jersey Turnpike, and other important structures, received the Allan R. Cullimore Award for Distinguished Service at the 44th commencement exercises of Newark College of Engineering on June 9. Mr. Needles, a Past President of ASCE, is the fifth recipient of the award, which was established in memory of Dr. Cullimore, first president of NCE.

Charles S. Hazen resigned recently as U. S. Bureau of Reclamation area engineer in Spokane, Wash., to head up water resource planning in West Pakistan for the Harza Engineering Corporation, which is under contract to the Pakistani Government. An employee of the Bureau for over 25 years, he had worked for the past six years in the Spokane office.

Richard J. Frazier heads the new research department of the Harry T. Campbell Sons' Corporation, at Towson, Md. As director of research Mr. Frazier will investigate new uses for manufactured products, in addition to developing improvements in manufacturing techniques and methods.

Victor C. Anderson, civil engineer, recently opened an office at his residence, 315 Pine Bluff Street, Malvern, Ark., for the general practice of structural engineering. Mr. Anderson previously served as bridge design engineer with the Arkansas State Highway Department at Little Rock.

Rock G. Taber, since 1944 affiliated with the Atlanta (Ga.) Gas Light Company, has been appointed chairman of the board of directors. Most recently he served as president of the board.

Arthur S. Hicks has been named district manager for the Philadelphia area by Centriline Corporation, a subsidiary of Raymond International Corporation. Before taking over his new duties, Mr. Hicks was manager of water line sales for the Dresser Manufacturing Division of Dresser Industries, Inc.

Radnor J. Paquette, professor of civil engineering at the Georgia Institute of Technology, has been appointed to serve as a member of the National Defense Executive Reserve for Public Roads.

Howard M. Bixby, since 1957 field engineer for the National Crushed Stone Association, has become project management engineer for the transportation division of the International Cooperation Administration, Washington, D. C. He was formerly with the U. S. Bureau of Public Roads.

Howard Simpson has been conducting a series of semi-weekly lectures on the analysis and design of thin shell roofs at the Massachusetts Institute of Technology under the auspices of the American Concrete Institute. Dr. Simpson, who is a member of Simpson, Gumpertz and Heger in Cambridge, Mass., recently resigned as associate professor of structural engineering at MIT to devote full time to his consulting practice.

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...begins with a

William C. Folk, as the new executive vice-president of the Kansas City office of Weitz-Hettelsater Engineers, will serve as administrative head of the engineering and design activities of the branch. Before joining the organization, he was executive engineer for General Mills, Inc., of Minneapolis, Minn.

Stanley W. Dziuban, Colonel, Corps of Engineers, and for the past year a member of the National War College class, took on new duties in June as the officer in the North Atlantic Treaty Organization Standing Group responsible for the structural program. Before entering the War College, Colonel Dziuban was deputy division engineer for the Corps in New England.

Joseph Albiez has been appointed general sales manager of construction machinery in the Curtiss-Wright Corporation's South Bend, Ind., division. Previously, he served as product sales manager and technical sales manager of Curtiss-Wright and as district sales manager of the Wooldridge Manufacturing Division of the Continental Copper & Steel Industry, Inc., at Santa Clara, Calif.

Finley G. VanBrocklin is a new addition to the staff of Smith & Loveless, of Lenexa, Kans., a division of the Union Tank Car Company. As sales representative, his territory includes all of Arkansas and Western Tennessee.

Harry S. Lewis, who recently completed two and one-half years in the Marianas Islands (Pacific Area) as engineering consultant to the U. S. Navy on Saipan and the Government of Guam, has joined the Taipei, Formosa, office of Thomas B. Bourne Associates, Inc., of Washington, D. C. The firm is consultant to the construction division of the U. S. Military Assistance Advisory Groups to the Chinese Nationalist Government.

J. J. Dvorak, as the new assistant division head in the Technical Division of the Humble Oil & Refining Company's Baytown, Tex., refinery, will direct the operations of the firm's central engineering branch. He was recently promoted from assistant department head.

[*Editor's note:* Samuel M. Bailey, chief of the engineering division of the U.S. Army Engineer District, Louisville, Ky., has been appointed by President Eisenhower as federal representative to the Wabash Valley Interstate Commission established by the Wabash Valley Compact. It was stated in error in the April issue that Mr. Bailey had severed his connection as chief of the engineering division of the Louisville District.]

Which is best?

CEMCOTE—cement mortar lined & coated steel water pipe.

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WRAPCOTE—cement mortar lined & asphalt wrapped steel water pipe

Seldom is a decision more critical and seldom is a choice more necessary than in selecting the proper water line to do the job. There is really only one long range measurement to follow—*performance cost.*

Performance cost is not so much considered with initial outlay as it is with the relation of performance to cost over time under varying conditions, standard as well as emergency. And When performance cost is the measure—steel water pipe is your only choice.

No other product gives you the strength, durability, carrying capacity, reliability, resiliency, and "bottle-tight" joints. Nor is any other water pipe as practical for installation and maintenance because of its ductility, adaptability and hi-beam strength.

But, within the great range of steel water pipes is the additional decision, what variety? Southern Pipe is experienced in helping you in this final important decision. Southern's line of STEELCOR products include such cement mortar lined pipe as CEMCOTE (cement coating), WRAPCOTE (asphalt wrapped), and TARCOTE (coal tar enamel wrapped), to meet your every economic and performance need. Call us for complete information.

No other western pipe producer offers our complete *packaged waterline service.*

Manufacturer of STEELCOR steel water pipe, including such lined and coated pipe as Cemcote, Wrapcote, Tarcote, Tarspun, Dipcote, and others.

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These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Electrical, Mechanical, Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a non-profit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 60 percent of the first month's salary if a non-member, or 50 percent if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include 8 cents in stamps for forwarding application to the employer and for returning when possible.

The New York office will be open on Thursday evenings until 7:00 o'clock for interviews.

Men Available

Construction Engineer, M. ASCE, B.S. in C.E., Registered. Experienced in supervision of construction of power plants and highways; planning and reports. Extensive foreign experience. Wide construction surveying. C-554.

Professor or Puplic Health Engineer, M. ASCE, B.S.C.E. Experienced in municipal and public health engineering; university faculty member; associate with consulting firm. C-555.

Civil Engineer, A.M. ASCE, B.S., B.C.E. Three years of broad civil engineering experience with consultants for public works; design, field investigations, reports, construction supervision. Seeks responsible position with growth potential. Location desired, Metropolitan New York area. C-556.

Civil Engineer or Instructor, A.M. ASCE, M.S. Some experience in highway and ten years of experience in teaching. Location desired, East or Midwest. C-557.

Civil Engineer, Highway, Office and Field, M. ASCE, B.C.E. Registered P.E. in New Jersey, Pennsylvania and Ohio, 34. Eleven years' office and field experience in all phases of highway and expressways. C-558.

Traffic Engineer, M. ASCE, B.S.C.E., Certificate in Highway Traffic, 28. Five years of experience as assistant traffic engineer of an Eastern State. Excellent varied experience in design and operations. C-559.

Construction Management, A.M. ASCE, B.S. in C.E. Three years as field engineer; six years on construction supervision for an architect. Location desired, East. C-566.

Structural Design Engineer, A.M. ASCE, B.C.E. Three and a half years of experience in the design of industrial type buildings and other steel structures and two years' in construction with reinforced concrete. Location desired, New York City, New Jersey. C-567.

Project Engineer, Bridges, M. ASCE, B.S.C.E., M.S.E. Ten years diversified experience including complete administration of jobs; supervision of design, detailing and drafting. Location desired, New York area. C-568.

Civil Engineer, M. ASCE, P.E., M.C.E., B.C.E. Eight years of diversified experience in municipal engineering, site surveying, design, construction, specification writing, estimating, inspection—highways, viaducts, tunnel; materials testing and stability analysis. Location desired, New York Metropolitan area. C-569.

Designer-Detailer (small consultant), M. ASCE, M.C.E. Five years consulting engineers for highways and bridges. Location desired, Mid and North Atlantic. C-570.

Sales Engineer, A.M. ASCE, B.C.E. Two and a half years of experience as sales engineer with an industrial manufacturer, product engineer with a concrete pipe manufacturer, and one year as structural designer with consulting firm. Location desired, New York area. C-571.

Project Administrator or Cost Analyst—Engineering Management, A.M. ASCE, B.S.I.M. and B.C.E. Performed in a staff capacity to the project managers of an engineering design firm in coordinating their projects along with cost analysis, yearly and monthly project schedules, estimates for manpower, completed project analysis, employment and adjustment to production, establish overtime operations and overhead budgets and control. Location desired, Delaware Valley. C-572.

Project Manager, M. ASCE, B.S.C.E., 35. Experience in consulting, including report and specification writing, preparation of designs, plans and estimates, and supervision of construction on sewer, sewage treatment and industrial waste treatment projects and as resident engineer on construction of sewage and water facilities. Also, design and field experience with equipment manufacturer, strength in electronics and selling experience. Location desired, Midwest or West. C-1102-Chicago.

Chief Engineer and/or Estimator, M. ASCE, B.S.C.E., 41. Fifteen years broad background of good construction experience in office and field, including bridges, heavy industrial, commercial and public works projects. Particularly strong at estimating and purchasing. Location desired, Ohio, but will relocate for right party. C-1099-Chicago.

Junior Civil Engineer, A.M. ASCE, CE, 32. Four years of experience in bridge department and six months drafting and computing with county. Se-1497.

Construction Manager, M. ASCE, CE, 35. Broad experience in all types of commercial, industrial and heavy engineering projects. Desires challenging position where intelligence and hard work will benefit our mutual interests. Salary, $12,000 a year. Location desired, Western U. S. Se-1190.

Project Engineer, M. ASCE, MSCE, Registered Professional Engineer, Massachusetts, 34. Eight years of experience with consultants—three years on highway design, supervision of design, studies, plans, estimates, specifications, one year resident, embank, drainage, bridges, pavements and four years on structural design, supervise studies, design of bridges, steel, concrete, pre-stress, client liaison, shop drawings. Salary, $10,000-$12,000 a year. Location desired, West Coast or Overseas. Se-1406.

Office and Field Engineer, A.M. ASCE, CE, 34. Three years of experience on building and zoning codes, administration, structural checking, subdivision checking, survey, draft, reports, design of streets, sewers and buildings. Salary, $8,450 a year. Se-1051.

Project Engineer, M. ASCE, CE, IE, age 33. Three years of experience in charge of design of facilities for missile bases, twelve years of experience supervising design and construction, contracts, cost, budgets on bridges, buildings, sewers highways, sewage treatment plants, tunnels, roads for city. Salary $12,000 a year. Location desired, Northwest. Se-873.

PRODUCTION ENGINEERS

To Locate in Florida

Desirable positions available immediately with very large progressive prestressed and precast concrete manufacturer. Salary commensurate with ability.

Send complete resume with recent photograph. Will contact qualified applicants and arrange for personal interview.

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Civil Engineering
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"The British Columbia Energy Board has been established by the Government of British Columbia to study and report upon energy resources, and requirements and other matters affecting energy development in the Province of British Columbia."

"The Board now invites applications for the position of Chief Engineer. Preference will be given to applicants with at least five years' experience in Power System Engineering.

"The salary range will be $12,000 to $15,000 per annum. Applications with curriculum vitae and references will be received up to July 20th by the Secretary, British Columbia Energy Board, 620 View Street, Victoria, B. C.

Construction Superintendent, Designer, M. ASCE, CE. Professional Engineer License in New York and Ohio, 35. Eight years of experience in charge of construction design, inspection of bridges including falsework and form design, sheeting and shoring, refinery units, foundations and super structures for contractors. Salary $12,000 a year. Location desired, West. Se-823.

Resident, Superintendent, A.M. ASCE, CE. Professional Licenses in California, Oregon and Washington, 40. Fourteen years of experience supervising design, construction, surveying, estimates on highway and bridge projects, tunnels, camp housing, docks and dock repair. Salary, $10,800 a year. Location desired, West Coast or Foreign. Se-1086.

Superintendent, M. ASCE, CE. Licensed Civil Engineer, 50. Twenty-one years of experience in charge of construction, cost estimates, budgets, bidding, design on industrial and commercial buildings, military projects, highways, irrigation and power projects. Salary, about $20,000 a year. Location desired, Foreign. Se-789.

Positions Available

Construction Engineer, for large multi-plant producer of chemicals and minerals, to design or collaborate in the design of pilot plants, new facilities and alterations to existing facilities applicable to all phases of the production of inorganic chemicals. Supervision of construction activities as required, from site preparation to erections and subsequent repair and maintenance procedures. Travel as required. Salary, $15,000-$18,000 a year. Headquarters, Chicago, Ill. W-8873.

Sanitary Engineer, graduate, with experience in design of pumping station, sanitary sewer systems, treatment plants and preferably design water distribution, for consulting engineering firm. Company pays placement fee. Salary, about $10,000 a year. Location, Virginia. W-8882.

.**Assistant Professor**, Highway Construction, graduate civil, with two to five years of field and office experience in highway, design construction and survey. Teaching experience highly desirable. Should be qualified to teach surveying, highway plan reading, highway drafting and layout, highway design. Salary, $6,020-$7,250 a ten month academic year. Extra compensation for evening school instruction. Location, New York suburban area. W-8886.

Operating Vice President for a multi-plant water works utility system. Must be qualified administrator, capable of assuming full responsibility for planning and directing both operations and construction programs. Must have proven practical experience and technical background required for efficient direction from administrative headquarters of local supervisory personnel. Submit resume containing a detailed description of all present and prior responsibilities, include present earnings, and list three references. Salary, $12,000-$14,000 a year. Location, East. W-8934.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for non-members, payable in advance.

Irrigation Design Engineer, graduate engineer, with a minimum of seven years of design background, preferably on major irrigation projects. Must be able to design small drop structures, irrigation turnouts and drainage pumping plants. Salary, to $13,000 a year plus allowance. Duration, 18 months or longer; can take family. Location, Middle East. F-8942.

Civil Engineers. (*a*) Office engineer, graduate civil, with up to ten years of experience, for design of sewage and water treatment plants, sewer and water systems. Permanent. (*b*) Field engineer, up to ten years of experience, to take complete charge of construction of $1,200,000 sanitary sewer system and sewage treatment plant. Relocation to another job after completion of this work. (*c*) Field engineer, up to ten years of experience, to take complete charge of field work in connection with preparation of final plans for sanitary sewer system and sewage treatment plant. Relocation to another job after completion of project. Location, upstate New York. W-9055.

Senior Structural Engineer, B.S.C.E. preferred, to 50; with five or more years of experience supervising an engineering department, responsible for detailing and erection drawings covering structural steel for industrial, commercial, church and school, buildings. While main duties are confined to supervision of engineering functions, will be required to cooperate with sales and production departments. In some cases will be required to work with contractor, only to the extent of straightening out engineering details. Company ships 800 to 1,100 tons monthly. Employer will negotiate placement fee. Salary, $10,000-$12,000 a year, plus bonus and fringe benefits. Location, Ohio. C-8119.

Engineers, (*a*) Construction superintendent, with at least ten years' heavy construction including caisson work and bridge foundations. (*b*) Senior project engineer, with considerable highway and bridge field construction experience including administration, coordination, scheduling, costs, reports, etc. Salaries open. Location, Louisiana. W-9057.

Associate Resident Engineer, prefer degree in CE or building construction (will consider ME or EE with construction of building structures experience). At least two years and preferably more in the field, supervising construction of manufacturing plants and prefer some supervision of office structures, lab buildings or other commercial type developments. Would cover full responsibility for supervision of smaller project or assisting one of engineering staff in the supervision of one or more larger jobs. Salary, $8,000 year depending on qualifications and experience. Promotion based on merit and performance. Location, West Coast (but must be willing to relocate). Sj-5276a.

Construction Engineer, CE, 25-35, experienced in heavy construction desirable, with ability to handle field engineering and layout, design falsework and concrete forms, job cost accounting, take-off and estimating. Personal interview required. Salary, $7,200-$9,600, depending on experience. Discuss payment of placement fee with employer. California. Sj-5264-R.

Designer, CE or equivalent, general civil engineering background. Experienced in developing plans for drainage, water, utilities, in subdivision development. Should be able to prepare specifications, do some layout work and direct draftsman for subdivision consultant. Salary, $7,200-$9,000. Location, San Francisco East Bay. Sj-5294-R.

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CIVIL ENGINEERING Magazine

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GRADUATE ENGINEERS, with professional experience in the fields of hydraulics, structural, and mechanical engineering to work in the Bridge & Stream Crossing of the U. S. Army at the U. S. Army Engineer Research & Development Laboratories, Fort Belvoir, Virginia (Located 15 miles south of Washington, D. C.) Applicants must be U. S. citizens and meet full U. S. Civil Service qualification requirements.

Starting salary for qualified applicants is $8810 p.a. Work requires a knowledge and application of hydraulics, structural, and mechanical engineering principles in the tests, modification design, construction, operation and maintenance of Army bridges, jacks and allied erection equipment, trucks & trailers, and various stream crossing equipment. Qualified engineers interested in employment in these Laboratories should address Application Form, SF-57, and requests for information to the Civilian Personnel Officer, Fort Belvoir, Va., making specific reference to this advertisement. Standard Forms 57 may be obtained from your Post Office.

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MORSE BOULGER INC.
BUILDERS OF THE MOST MODERN INCINERATOR PLANTS IN THE WORLD

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City ______ State ______

Applications for Admission to ASCE April 30-May 28, 1960

Applying For Member

Raymond Victor Adolphson, Steamboat Springs, Colo.
Wilbur Dean Altus, San Luis Obispo, Calif.
Syed Abdul Basith, London, England
Edward Dupree Brandt, Houston, Tex.
Norman Bradley, Los Angeles, Calif.
Boyd Shreve Brooks, Glen Burnie, Md.
Leroy Marston Cahoon, Boston, Mass.
George Ramsay Carr, Vancouver, B.C., Canada
Howard Tong Chang, Honolulu, Hawaii
Burnham Standish Colburn, Jr., Asheville, N.C.
Rob Morris Collier, Menlo Park, Calif.
Harry Arlos Cornell, Denver, Colo.
Donald Keith Cracraft, Long Beach, Calif.
James Edgar Curry, Antlers, Okla.
Prahlad Das, Roorkee, India
Oliver Erwin Deatsch, Modesto, Calif.
Ernest Voldemars Dravnieks, New York, N.Y.
Charles Elra Dresser, Tujunga, Calif.
A. E. Durber, Washington, D.C.
James Eugene Fair, Florence, Ala.
William Orrin Farnam, Jr., Atlanta, Ga.
Peter David Faure, Cape Town, South Africa
Francisco Fontes Lima Filho, Bahia, Brazil
Fred Fischer, Jr., New York, N. Y.
Clifford Lindell Flippo, Wilson Dam, Ala.
George John Geisser, Jr., Riverside, R.I.
William Wayne Gentry, Seal Beach, Calif.
Arthur Gervais, Jr., Denver, Colo.
Ray Albert Gibbs, Clinton, Iowa
Hugh Quintin Golder, Toronto, Ont., Canada
Frederick Charles Greenfield, Manchester, England
Amos Conrad Griessel, Kansas City, Mo.
Cavis Beecher Ham, Albany, N.Y.
Jun Ho Ham, Seoul, Korea
J. Roger Hayden, Columbus, Ohio
Harold Dunn Hersum, Augusta, Me.
Pei-Tung Hsu, Montreal, Quebec, Canada
George Jack Hummel, Los Angeles, Calif.
Muhammad Hussain, Gujrat, Pakistan
Gottlieb Alexander Jacob, Walla Walla, Wash.
Orville Thornton Johnson, San Diego, Calif.
Ross Donald Johnson, Sanborn, N. Y.
Floyd Alan Knudston, San Francisco, Calif.
Recai Mehmet Kutan, Ankara, Turkey
William Irvine Low, Durban, South Africa
Clinton Fredrick Loyd, Long Island City, N.Y.
Harry Edwin Lutz, Turner, Kans.
Kjell Ake Hjalmar Magnusson, Malmo, Sweden
Sherwin A. Mandelblatt, Pittsburgh, Pa.
Sol Marenberg, New York, N.Y.
Anthony Louis Marolda, Haddonfield, N.J.
Albert Duncan McDonald, Ontario, Canada
Peter Joseph McMahon, Los Angeles, Calif.
Wayne Michael McNally, Buffalo, N. Y.
James Kent Meehan, San Diego, Calif.
Ole Fredrik Melleby, Denver, Colo.
Griswold Lamour Moeller, New York, N.Y.
Arthur Edwin Monthey, Duluth, Minn.
Edward Nicholas Mose, Chicago, Ill.
Shiw Sahai Naraine, The Hague, Holland
Dov Nedavia, Tel-Aviv, Israel
John Murray Nutter, Phoenix, Ariz.
Henry Hajime Oga, Sacramento, Calif.
Clarence Collins Parker, Hamilton, Ont., Canada
Harry Edward Peel, Augusta, Ga.
Ildemaro Perez-Ramirez, Caracas, Venezuela
Bill Edward Polasek, Jr., Tacoma, Wash.
William Howard Reed, Jr., Savannah, Ga.
John Patrick Reilly, Eureka Springs, Ark.
Wilfredo Lopez Reyes, Baltimore, Md.
Alan D. Roberts, La Jolla, Calif.
John Roe, Queensland, Australia
Raymond Saibini, Reno, Nev.
Howard Theodore Schulze, St. Paul, Minn.
George Frederick Brian Scruby, London, England
Niranjan Sen, Washington, D.C.
Renubhusan Sen, Washington, D.C.
John William Shannon, Sarcamento, Calif.
Clarence Bertram Sieber, Adelaide, South Australia
Maxime Maurice Walter Smith, Vancouver, B.C., Canada
Charles William Stanley, Bloomfield, N.J.
Mehmet Sumra, Konya, Turkey
Frank Albert Swatta, Memphis, Tenn.
Ven-Chao Teng, Taoyuan, Taiwan
Ahmed Talaat Tewfik, Cairo, United Arab Republic
Ronald Tinyow, Sydney, N.S.W., Australia
Antonio Tiverios, Glenview, Ill.
Eduard Ostria Trigo, Tarija, Bolivia
Martin Laurence Tropauer, Loja, Ecuador
Hsien-San Tsang, Oakland, Calif.
James Neil Turnbull, Palmerston North, New Zealand
Adolfo Tylius, Niagara Falls, N. Y.
Yun Wang, Taiwan, China
William Plummer Weldon, Nashville, Tenn.
Armand Edward Werle, Walnut Creek, Calif.
Eugene Rudolph Wertepny, Springfield, Ill.
James Alexander Whyte, San Francisco, Calif.
Richard Walter Wilke, Washington, D.C.
Wendell Rogers Wilson, Chicago, Ill.
Victor John Clifford Woodward, Addis Ababa, Ethiopia
George Bennett Wynne, Raleigh, N.C.
Tsang Tze Yih, Taipei, Taiwan

Applying For Associate Member

Dorr Marshall Anderson, Chicago, Ill.
Karl Russell Anderson, Mobile, Ala.
William Murlen Anderson, Jr., Sacramento, Calif.
Hakam Atasi, Damascus, Syria, U.A.R.
Yilmaz Omer Badur, Ankara, Turkey
Joseph Vincent Baglio, Boston, Mass.
Brahamnyapura Narasimhamurthy Rao Brahmanya Vittal Rao, Madison, Wis.
Ignacio Cano Rivera, Colombia, South America
Huai-Fang Chen, Taiwan, Republic of China
George Grant Cherrington, Toronto, Ont., Canada
Roy Steers Conradene, Columbia, Mo.
Roger Lee Raymond Corinth, Urbana, Ill.
Jagdishchandra Jagjiwandas Doshi, Calcutta, India
Themistocles Alexander Dracos, Zurich, Switzerland
Harry Joseph Duffey, St. Louis, Mo.
Stephen Peter Fricano, Monagas, Venezuela
Joseph William Ganci, Springfield, Ill.
Richard Somers Griese, Glendale, Calif.
Sat Prakash Gupta, Troy, N. Y.
Donald Louis Hansen, Richland, Wash.
John Patrick Harkin, Ames, Iowa
Tseng Huang, Urbana, Ill.
Thekkekara Verghese Jacob, Kerala State, India
Elmer Albert Jenkins, Jr., Fresno, Calif.
Arthur Charles Korn, Anaheim, Calif.
James Mitchell Landin, Littleton, Colo.
Chiu-Ching Lim, Manila, Philippines
William Gilbert Loveridge, Trenton, N. J.
Emanuel Isaac Marks, Cincinnati, Ohio
Thomas Benson McKinnon, Kingsport, Tenn.
Vinodchandra Rasiklal Mehta, Troy, N. Y.
William Martin Menger, New York, N. Y.
H. Reha Mesara, New York, N. Y.
George Susumu Morimoto, Honolulu, Hawaii
Robert Raymond Mortenson, Vallejo, Calif.
Charles Jerry Nelson, Los Angeles, Calif.
Richard Dale Osterman, Billings, Mont.
Angelo Fred Padavano, Mineola, N. Y.
Constantin Vasil Parathiras, Raleigh, N. C.
Richard Russell Phelps, Beaumont, Tex.
Ganganna Ranganna, Sydney, Australia
Marshall Foster Reed, Jr., Philadelphia, Pa.
Nufid Abdulwanab Samarai, Manhattan, Kans.
Ramesh S. Shad, Troy, N. Y.
Francisco de Apula Sierra M., Medellin, Colombia, South America
Duane Smrha, Sacramento, Calif.
Frederick Adrian John Stein, New South Wales, Australia
William Munera Toro, Medellin, Colombia, South America
Syed Usman Padshah, Blacksburg, Va.
Naresh Chandra Vasishth, Portland, Ore.
Harlan Edward Warwick, Glendale, Calif.
Paul Jones Webber, Bellport, N. Y.
John Henry Wiggins, Jr., Urbana, Ill.
Donald Merlin Winton, San Leandro, Calif.

[*Applications for the grade of Associate Membership from ASCE Student Chapter Members are not listed.*]

Non-ASCE Meetings

American Institute of Electrical Engineers. Pacific general meeting at the El Cortez Hotel, San Diego, Calif., August 8-12.

American Public Works Association. Public works congress and equipment show at the Coliseum, New York, N. Y., August 14-17.

American Society of Mechanical Engineers and American Institute of Chemical Engineers. Heat transfer conference and exhibit at the Statler-Hilton Hotel, Buffalo, N. Y., August 15-17.

American Welding Society. Fall meeting at the Penn-Sheraton Hotel, Pittsburgh, Pa., September 26-29.

National Council of State Boards of Engineering Examiners. Thirty-ninth annual meeting at the Hotel Multnomah, Portland, Ore., August 18-20.

Prestressed Concrete Institute. Sixth annual convention at the Statler-Hilton Hotel, New York, N. Y., September 27-30.

Public Health Service. Symposium on water quality data collection and utilization at the R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio, August 29-31.

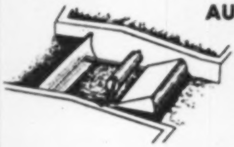
WATER MEASUREMENT

. . . accurate easy to read

PARSHALL MEASURING FLUME

For open channels in industrial plants, waterworks, irrigation systems and sewage disposal plants. Galvanized steel.

- Self-cleaning
- Easy to read
- Low head loss
- Throat widths: 3" to 10'



AUTOMATIC CONTROL GATES

Regulate flow and water levels regardless of water supply variation. Ends need for 24-hour supervision . . . prevents waste, flood damage and overflow. No floats, sheaves, motors or cables.

WELL CASING Scientifically designed for all soil conditions. Made of mild, stainless and alloy steels for long life and low initial cost. Five perforations and four field joints for fast assembly. Write for free literature.

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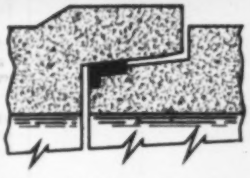
Fast, water-tight coupling for OFFSET CONCRETE PIPE *with*

TYLOX "C-P" GASKETS



Type "C-P" TYLOX under full compression on offset concrete pipe.

TYLOX "C-P" Gasket is designed for concrete sewer pipe having either single or double tongue offsets. Gasket consists of heavy base, multiple sealing fins, and a positioning flange which overhangs the edge of the tongue offset. "Locking" effect of the flange holds gasket in true position as pipe is coupled.

"C-P" Gaskets are the true compression type, available in either rubber or neoprene, and withstand head pressures up to 50-feet. They may be installed at the job site, or the pipe manufacturer's plant. Specially compounded to resist sewerage and industrial waste acids, they never deteriorate. Write for brochure.

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ALUMINUM
GRATING
...WITH
"LOCKED-IN"
CROSS BARS!
Gary Galok*

SUPER ALUMINUM GRATING

Extra Strong! Exclusive swaging and forming process prevents cross bars from turning, twisting, coming loose or falling out . . . provides greater strength and rigidity than gratings using obsolete methods of joining bars. Non-rusting and corrosion-resistant . . . ideal where chemical conditions prevail.

Lighter Weight! High strength to weight ratio. Minimum deflection . . . easier to install.

Better Looking! Can be used for decorative purposes, sun shades, grilles, etc. Can be anodized in sunfast colors to blend with surroundings.

Available with serrated or plain bars—in all sizes to meet practically every requirement.

Write for Bulletin C14R

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Grating Division, Gary, Indiana

New steels are born at Armco

They **TESTED** our pipe like this **50 YEARS AGO!**

Today you have a better check.

When this picture was taken, about 1910, engineers and builders had practically no backlog of experience with corrugated metal pipe. Armco Pipe had been on the market only a few years. So tests such as this gave buyers confidence.

Today there is a better test at your disposal—the test of more than 50 years of actual service. Through these service records you can view the performance of Armco Corrugated Metal Pipe in all kinds of jobs. Storm sewers, sanitary sewers, utility conduits, culverts, tunnels, stream enclosures and bridges are some of the applications in which Armco Pipe has proved itself.

Armco Pipe is a member of a full line of drainage and construction products made and sold by Armco. You can get complete facts on versatile Armco Corrugated Metal Pipe in our new catalog. Use the coupon to order your free copy. Armco Drainage & Metal Products, Inc., 6400 Curtis Street, Middletown, Ohio.

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Sixteen pages of Specification and Application Data

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4

5

1. Inspection shows sewer in Pocatello, Idaho, installed in 1914, is in excellent condition. **2.** Armco SMOOTH-FLO® Sewer Pipe being installed for real estate development. **3.** This Armco Pipe functions as a conduit for utility lines under railroad. **4.** Armco Research Engineer checks 20-year performance record of Armco Pipe under the Pennsylvania Turnpike. **5.** Conveyor housing is a 96-inch diameter Armco Pipe.

Steel

ARMCO DRAINAGE & METAL PRODUCTS

ARMCO

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Pre-Engineered Steel Buildings

THE COMPANY NOW CLAIMS the widest range of steel building types and sizes for commerce and farming. The new line also fits the width and height requirements of heavy industry, it is stated.

Fits Heavy Industry Requirements

Clear-span widths are reported to range from 5 ft 4 in. up to 120 ft; sidewall up to 40 ft. In addition, there is a whole new series of buildings with a single slope roof and in widths up to 24 ft.

A new choice of roof slopes is offered in the self-framing and rigid-frame buildings from 8 ft to 120 ft wide. Buyers have an option between the new low silhouette roof (2:12 pitch) or the more traditional 4:12 pitch. The single-slope roof is said to offer more variety—starting with a nearly flat roof design.

Another feature is described as a "revolutionary roof structure"—a continuous beam-type purlin system in the roof of rigid frame and truss-type buildings. Roof framework is lighter and more rigid. Purlins are above the rafters, out of the way of wiring, sprinklers, ductwork, insulation and other equipment. Finishing is said to be faster, easier and more economical than the conventional roofing system.

Another innovation is a special industrial interior wall panel designed to the same 16-in. module as the exterior Steelox panels. These liner panels are ready to snap in place and are moisture-proof and fit all Armco buildings.

A new feature is a sculptured Steelox curtain-wall panel that provides an attractive shadow effect with a rugged structure. **Armco Drainage & Metal Products, CE-7, 4010 Curtis St., Middletown, Ohio.**

Industrial Interior Wall Panel

Rotary Mixers

MAJOR IMPROVEMENTS TO THE Pulvi-Mixer and Trav-L-Plant line of rotary mixers for soil stabilization and highway construction have been announced.

The most immediately recognizable change is the modern appearance of the equipment, with its low, squared-off hood and fenders, a change which has greatly improved accessibility to all parts of the engine and drive system and has provided greater ventilation during operation.

Safety for the operator has been taken into consideration with the new design which features a catwalk alongside the operator's station, and improved visibility over hood and fenders.

Power steering on both machines has been improved to provide simpler upkeep and maintenance. **American-Marietta, Co., Construction Equipment Div., CE-7, Milwaukee 1, Wisc.**

One-Half Ton Roller

IDEAL FOR USE ON smaller street contract, as well as on parking lot and driveway jobs, the ½ ton roller is used extensively by Golf and Country Clubs for rolling greens and tennis courts, and by Landscape Contractors and Nurserymen in the preparation of new lawns and in the maintenance of existing turf. Featured is its ability to work flush against building lines and curbs, high clearance of curbs, and right turning radius. **General Engines Co., CE-7, U.S. Route 130, Thorofare, N. J.**

New Wrecking Bar

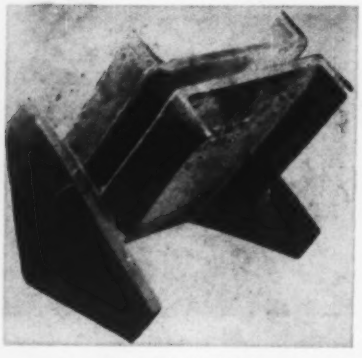
THE DOUBLE CLAW WRECKING BAR, manufactured in 18, 24 and 30-in. sizes, has the advantage of permitting nail-pulling in hard to reach corners and near baseboards, since the ends are bent at angles which facilitate this close-in work. **Klein-Logan Co., CE-7, 122 S. 13th St., Pittsburgh 3, Pa.**

Pruyn Cast Steel Point

THE FLANGES OF AN H-Pile are its weakest point. When driven through hard ground containing obstructions such as boulders, rock fragments, etc., they bend, buckle and are sometimes even completely torn off in the process of driving. The Pruyn Cast Steel Point is designed to correct this weakness, as it fits snugly over the end of an H-Pile, is welded in place and completely protects the flanges as well as the web from distortion and damage from all obstructions encountered in the driving process.

Made of high carbon steel, the point is tough and strong enough to withstand the abrasive action of all obstructions encountered in the hardest soil. The engineer is assured of obtaining the full bearing capacity of the pile when driven to refusal. It is made to fit all weights and sizes of the H-Piles now on the market.

The welding of the point is quick and simple. After the casting is placed in position the two flanges of the H-Pile are welded to the scarfed shelves on the outside of the casting. Two or three inches of the channel flanges are then welded to the inside flanges of the H-Pile and the job is done. The piles are now ready to be placed in the leads and driven to refusal. **Associated Pipe & Fitting Co., Inc., CE-7, 262 Rutherford Blvd., Delawanna Section, Clifton, N. J.**



Cast Steel Point

STEEL H-PILE

foundations support two new Massachusetts bridges

Over 450 steel H-piles were driven for the foundations of the Valley St. Bridge.

First of over 200 steel H-piles being driven to bedrock for abutments and piers for the new Webster St. Bridge.

Bethlehem steel H-piles were driven to bedrock for the foundations of two new six-lane bridges at Medford, Mass. For the Valley St. bridge, over 450 steel piles, 30 to 75 ft long, were driven to bedrock. At the Webster St. location, over 200 steel piles 80 ft long were driven for abutments and piers.

Both bridges are on relocated Route 28, which forms a part of the Interstate Highway System. Pile-driving contractor for both jobs was W. P. Carter Excavating Co., Inc., of Natick. Berke Moore Co., Inc., Boston, was general contractor.

BETHLEHEM STEEL COMPANY
Bethlehem, Pa.
EXPORT DISTRIBUTOR
Bethlehem Steel Export Corporation

Steel

for Strength
. . . Economy
. . . Versatility

BETHLEHEM STEEL

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Polysulfide Modified Adhesive Mortar Fills Dip

How TO FILL A RUT or dip in concrete roadways quickly yet with watertight permanence, has been demonstrated recently by a remedial project on the Richmond-San Rafael Bridge in California.

Caused by a failure of mortar surfacing, a dip in the bridge roadway was a potential threat to highway safety. Up to ¾ of an inch deep and 10 ft wide, the dip stretched 36 ft across several lanes. Because it threatened to enlarge, the California Division of Highways decided to begin repairs as soon as possible.

Conventional repair techniques would have required removal of base concrete until some of reinforcement steel was bared. The big drawback to such a technique is the amount of time required to make the repair. Even the repair with polysulfide modified epoxy adhesive and a new concrete overlay has a drawback, as the time required for the concrete to set and become strong would still tie up traffic longer than was desirable.

The fact that only a ¾ in. overlay was required to fill the dip was what finally led the engineers to their decision to employ a polysulfide modified epoxy mortar—a mixture of the adhesive and aggregate. By so doing the time the lanes had to be closed to traffic would be held down to only a few hours. **Thiokol Chemical Corp., CE-7, 776 N. Clinton Ave., Trenton 7, N. J.**

Truck Range Extended

To MEET AN INCREASE demand from haulers of steel, pipe and other long materials, the company's range of International trucks with one-man, 50-in. wide cabs has been extended to cover models from 16,000 to 47,000 lb gross vehicle weight.

All cabs are factory installed and feature a roof safety hatch that permits cab entry and exit when side doors are blocked by loads; they are available on both four-wheel and 6-wheel chassis.

Design of the centered, narrow cab results in an unobstructed area 21 in. wide that runs the full length of both sides of the truck. An optional front outrigger prevents lateral load shifting. In addition to the full length side loading areas, the entire space behind the cab is available for cargo.

In many instances, one of these trucks with narrow cab can replace a tractor-trailer unit, as loads can extend beyond the limits of the truck, both front and rear. It can maneuver in places where tractor-trailer operation would be impractical. **International Harvester Co., CE-7, 180 North Michigan Ave., Chicago 1, Ill.**

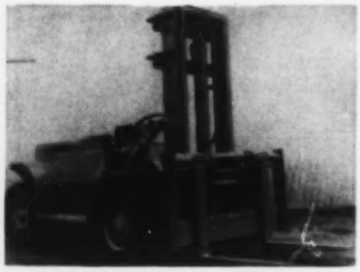
Heavy-Duty Fork Truck Attachments

A NEW SIDE SHIFTER and a combination side shifter-slope piler attachment designed for use on Yardlift fork trucks of 15,000 through 20,000 lb capacity are now available.

The side shifter eliminates excessive fork truck maneuvering by allowing operator to center forks under load and accurately set down loads in confined areas.

The new A-20 side shifter provides a maximum shift of 6 in. on either side of fork truck's center. Shifting carriage moves on a large tube and slide at the top and on two trundle rollers at the bottom to minimize friction. Grease fittings are provided on tube and slide. Bottom rollers have oil impregnated bushings and require no lubrication.

Combination side shifter-slope piler consists of a side shifter, similar in construction to the A-20 unit, and a hydraulic arrangement which pivots forks five degrees about center line of carriage. The ability of the operator to align forks with a load which is not level is a desirable feature when handling heavy bulky loads over rough or sloping terrain. **Clark Equipment Co., CE-7, Battle Creek, Mich.**



New Combination Attachment

Lightweight Roof System

AN ECONOMICAL NEW LIGHTWEIGHT roof system has been awarded a two-hour fire rating by Underwriters' Laboratories.

The assembly consists of a 2-in. slab

(Continued on page 125)

DON'T GUESS!

use an ACKER SOIL SAMPLING KIT for accurate sub-surface information

With accurate sub-soil information, *you avoid* costly trouble later on. And, what better way to get this information than with a portable, easy to use Acker Soil Sampling Kit. For here is a versatile collection of twelve soil sampling tools packed in a handy steel kit that can be carried in any car.

Write today for prices and Bulletin 26. CE

Acker Soil Sampling Kit being used for test borings for bridge foundation. Over 30 years of soil sampling experience make this Acker kit the most useful you can buy!

ACKER DRILL CO., Inc. P.O Box 830
Scranton, Penna.

A·M

PRECAST CONCRETE SEWER ELEMENTS

for lasting service at low cost

American-Marietta offers concrete manholes and a variety of pipe styles—each precast for faster installation at less cost—each designed to do a specific job better. A-M Concrete Products plants are strategically located throughout the country to assure quick delivery. Write for the name of the plant nearest you and ask for free literature on any of the products illustrated below.

HI-HED® PIPE

Saves trench width in congested areas

INNER CIRCLES®

Minimizes surface excavations, makes salvaging of old sewers easier

LO-HED® PIPE

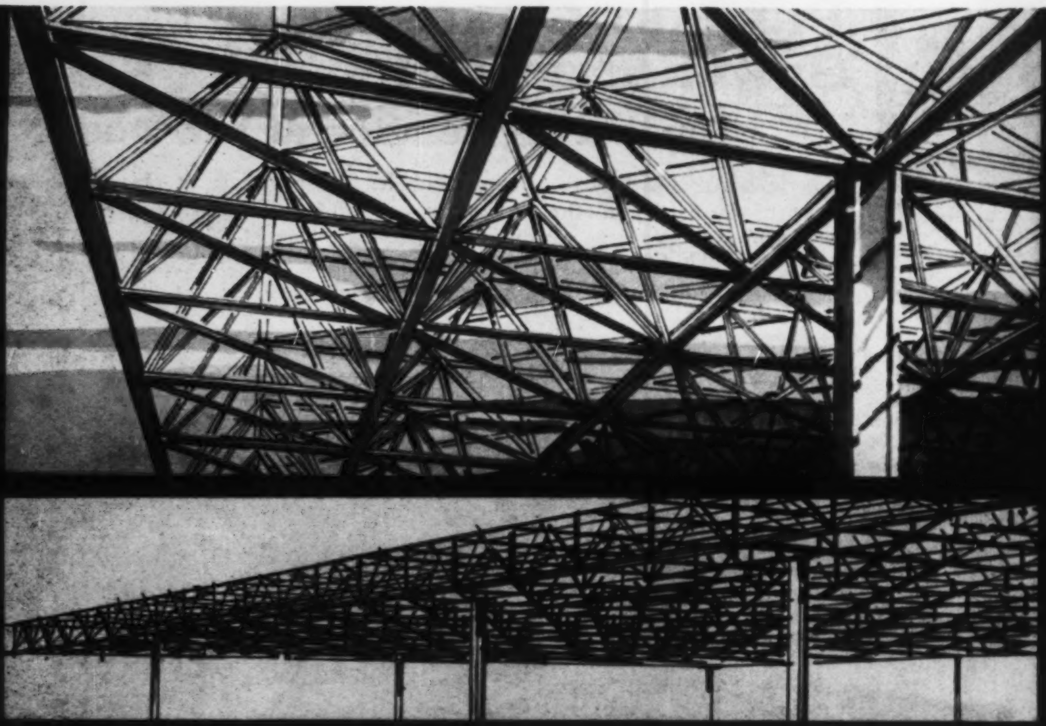
Minimum depth of cut—affords increased cushion of cover

CONCRETE PIPE

Strengths pretested to eliminate guesswork

A·M

AMERICAN-MARIETTA COMPANY
CONCRETE PRODUCTS DIVISION
GENERAL OFFICES:
AMERICAN MARIETTA BUILDING·
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE WHITEHALL 4-5600



CONSULTING ENGINEER: DR. WAYNE C. TENG, CHICAGO

There's an Inland Structural Steel for every new construction idea

Space Framing . . . something new in the world of structural design . . . is beginning to capture the imagination of architects, engineers and builders, everywhere. Utilizing the strength and design flexibility of structural shapes to span long distances and enormous free space areas, it offers both a new approach to the solution of engineering problems, and an exciting contribution to the aesthetics of contemporary architecture.

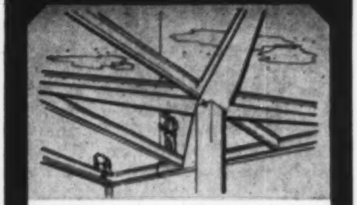
Because Space Framing is a 3-dimensional concept, it makes use of the full potential value of every supporting member, achieves thrust and counterthrust simultaneously, and stabilizes weight. In contrast to 2-dimensional triangular elements in conventional plane construction, the basic unit in Space Framing may be the 3-dimensional tetrahedron, hexahedron or any similar basic form. Multiples of such elements can be used, varying size and pattern, to achieve simple curves, S or reversed curves, domes, variable shapes, thus permitting unlimited structural and design freedom.

Construction cost per square foot is now comparable to conventional techniques, when efficiently engineered. Steel structural sections can be prefabricated, delivered to the site and erected speedily. What's more, modern electronic computers may be employed for the mathematics involved, markedly reducing design time. In domes, 3-dimensional construction minimizes the possibility of buckling and because of the clean geometric pattern, results in a remarkably beautiful visual effect.

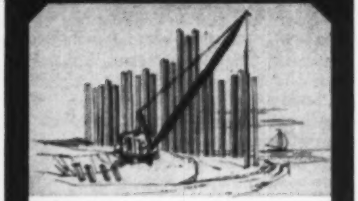
For more information on modern space framing methods, see your local fabricator who now has INLAND structural steels available in all shapes and sizes—or call the American Institute of Steel Construction office in your area.

Use Steel *For Modern Construction*

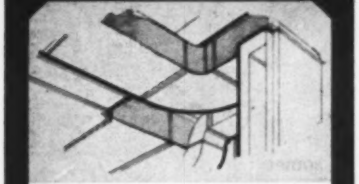
other Inland construction products



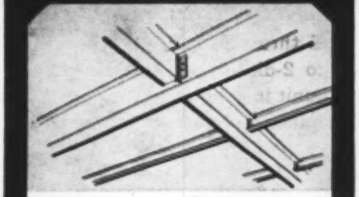
INLAND STEEL PLATES are offered in a wide range of gages and sizes with metalurgical and physical properties tailored to every construction requirement.



INLAND BEARING PILES AND STEEL SHEET PILING are used in foundations, retaining walls, coffer dams and other excavating and supporting jobs.



INLAND TI-CO® GALVANIZED SHEETS are the popular choice of metal contractors who install miles of air handling duct work in the largest commercial buildings. Their nonflaking quality adds years of corrosion-resisting service.



WIDE FLANGE BEAMS are the answer wherever more strength with less weight, longer spans with more open floor area, is the goal. Sizes from 8′ to 24′.

INLAND

INLAND STEEL CO.

30 W. Monroe Street • Chicago 3, Ill.

of vermiculite insulating concrete over a vented corrugated steel deck supported on precast concrete joists. The corrugated sheets are welded to steel plates cast into the top chord of the joists.

The under side of the deck is fireproofed with ⅞ in. of vermiculite acoustical plastic sprayed directly to the steel. The joists were sprayed with acoustic $\frac{1}{16}$-in. thick for a uniform appearance throughout.

The new system elimates a suspended ceiling, reduces wall height, and combines fireproofing and acoustical correction in one material that can be applied quickly. **Vermiculite Institute, CE-7, 208 South LaSalle St., Chicago 4, Ill.**

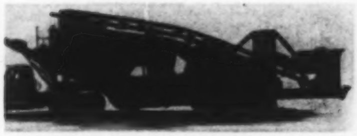
Portable Crushing & Screening Plant

One of the largest, portable, duplex crushing and screening plants ever produced and in full field operation has been announced.

Using a big 1536 jaw crusher in perfect balance with a 40-in. dia x 30-in. wide roll crusher, "Pioneer's Productioneer" produces the greatest actual capacity of any portable unit ever built and operating, the manufacturer states.

In addition, this giant, which gobbles boulders up to 14 in. with ease and turns out up to three sizes of material, uses a new design, high speed, 5 x 14 ft 3-deck vibrating screen that has 70 sq ft of specification deck. Its unique design also allows changing the product deck without removal of top deck—and the second deck screen cloth may be removed from either end.

For increased travel ease, the rear assembly (including the 90-in. x 28-in. bucket wheel and hopper) may be quickly detached without the use of a crane. And it's self-locating for easy replacement. **Pioneer Engineering, Div. of Poor & Co., Inc., CE-7, 3200 Como Ave., Minneapolis 14, Minn.**



Uses High Speed Vibrating Screen

Vacuum Filters

An important development in industrial filtration, successful washing of the filter medium during continuous operation, has been applied to the new EimcoBelt vacuum filters.

The EimcoBelt filter media washing principle eliminates blinding of the filter medium even when handling the most difficult slurries. In fact, according to the company's filtration experts, The EimcoBelt is now being used to filter glutinous materials and slurries containing low density solids which vacuum filters previously have not been able to handle.

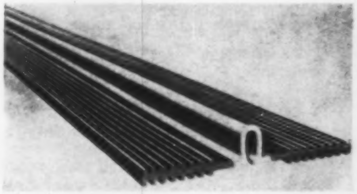
The media cleaning arrangement is versatile. For difficult slurries additional headers can be located to provide more washing capabilities. And on the EimcoBelt it is possible to wash both sides of the medium if it is desirable to do so.

Pressure of the cleaning water sprays can be adjusted to suit the individual application. **The Eimco Corp., CE-7, P.O. Box 300, Salt Lake City 4, Utah.**

New Waterstop

An entirely new concept of waterstop engineering is introduced with the company's new Sealtight Duo-PVC Waterstops, which are extruded simultaneously from two top-quality PVC compounds.

The PVC utilized in the center area is compounded to combine strength with maximum flexibility, whereas the multiple-rib area is extruded from a PVC compound that offers great strength with a desirable rigidity. The manufacturer reports that Sealtight Duo-PVC Waterstops are the first ones designed to handle expansion correctly without stretching the material or stressing the multiple-rib area. This is accomplished with the use of a U-Bulb center area design that will mechanically expand up to 1½ in. If greater expansion occurs the Duo-PVC material will accommodate it safely.



Handles Expansion Correctly

The opening to the U-Bulb is protected by a thin membrane, another exclusive feature, that prevents infiltration of concrete during pouring. This membrane is designed to tear under expansion and allow the U-Bulb to accommodate expansion heretofore thought impossible. **W. R. Meadows, Inc., CE-7, 26 Kimball St., Elgin, Ill.**

EQUIPMENT, MATERIALS and METHODS

(continued)

Thin Shell Roofs

THE COMPANY'S PLASTICS ENGINEERS have proposed a construction concept by which they believe architectural freedom and construction economies in the design of thin shell roofs can be achieved.

The concept introduces the use of foamed plastic planks in a triple capacity: as a form for the permanent roof; as thermal insulation; and as an effective vapor barrier. The plastic form boards of Styrofoam, Dow foamed polystyrene, are bent to the desired roof contour, and become an integral part of the roof structure. They also provide a base for interior decoration.

An important and intriguing use of thin shell construction has reached world-wide proportions. Widespread use in the United States has been hampered by the high labor and material costs of elaborate form work and supports. The proposed technique uses Styrofoam to create the desired surface previous to and act as a support for the application of the structural roof material. Much of the elaborate form work is eliminated. **Plastics Technical Service, The Dow Chemical Co., CE-7, Midland, Mich.**

Ridgid Chain Wrenches

TWO NEW CHAIN WRENCHES expand the Ridgid Work-Saver line of wrenches to 44 different types and sizes. Built for long rugged use, they are designed especially for work in extra tight quarters and feature fast, ratchet-like action in either direction, from either side. The chain gives tight grip without crushing on all round, square or irregular shapes. Tempered steel link chain has large easy-to-grab finger ring for fast adjustment. The chain catches quickly and securely on double lugs.

Two models are presently available. No. C-14 handles up to 2-in. pipe and fittings; No. C-18 up to 2½-in. pipe and fittings. As in all other Ridgid Wrenches, sturdy, comfort-grip I-beam handle is made of alloy malleable and is guaranteed not to warp or break. **The Ridge Tool Co., CE-7, Elyria, Ohio.**

Low-Priced Solid-State Calculator

A LOW-COST, SOLID-STATE punched card calculator, the IBM 609, can be used for the entire range of accounting and control applications as well as for engineering problems. It is able to perform earthwork computations for road-building projects, an application usually handled by far more costly equipment.

The machine's solid-state circuitry combines the functions of input, calculation, storage and output in a single compact cabinet. With vacuum tube machines, several units are required.

Low-Priced

The basic 609 is equipped with 240 positions of magnetic core storage, which can be increased up to 384 positions at the customer's option at slightly higher prices.

All program steps are non-sequential, which means that they can be used in any order, looping back and forth to carry the problem to solution. The number of program steps can be increased from the minimum of eighty to a maximum of 144. **International Business Machines Corp., Data Processing Div., CE-7, 113 East Post Rd., White Plains, N. Y.**

Laboratory Soil Pulverizer

A SOIL PULVERIZER FOR LABORATORY use is now being manufactured. This ma-

(Continued on page 127)

Hydraulics Division Conference, Seattle, Wash.

Advance Reservation Request

August 17-19, 1960

This is merely an indication of probable attendance, to help the local committee in its planning. No obligation is involved in returning this form. Please do not return this if you have previously indicated your probable attendance.

Send to: 1960 National Conference Committee
Hydraulics Division ASCE
Room 201, More Hall
University of Washington
Seattle 5, Wash.

Please complete the following:

Total size of party: ....adults

..................children, ages ....

I expect to request:

..............Dormitory housing ....Hotel room(s)

..............Motel housing ....No housing

Please send Chamber of Commerce Information ....

Number planning to attend scheduled events:

	No. of Tickets
General Program:	
Skagit Tour ($7.50, includes meal, transportation)	....
Salmon Barbecue	
(Adults, $8.00, includes transportation)	....
(Children, $5.25, includes transportation)	....
Conference Banquet ($3.25)	....
Ladies' Program:	
Wednesday Luncheon ($1.50)	....
Scenic Tour	....

Name ....

Address ....

....

chine was developed by the U.S. Bureau of Public Roads and has the three-fold merit of reducing the mechanical work to a minimum, eliminating most of the dust hazard and reducing the clay fraction with little or no reduction of the aggregate particles.

The pulverizer is essentially a ball mill in which the clay lumps are broken up by the action of loose rubber covered steel bars in rotating steel drums. The drums are light steel with quick closing lids. The rotating device consists of a welded steel frame with rubber covered shafts and a motor drive. The drums with the samples and bars are placed on the shafts and rotated for a given time depending upon the texture of the material. The operation is very simple due to the removable feature of the drums. **Hogentogler & Co., CE-7, 5218 River Rd., Washington 16, D. C.**

New Support Lagging

Availability of a new, economical and versatile support lagging for use as cribbing in mining and construction industries has been announced.

Light, easy to handle, fireproof, and inexpensive, the support lagging has a ribbed surface which permits interlocking when overlapped with the next lagging mat. This not only increases strength of the wall system and prevents dangerous gapping, but eliminates need for anchoring the mat, thereby decreasing installation time.

Economical and Versatile

Used to form a stable wall between rib flanges or sets and the wall of an excavation, the support lagging provides protection from falling rock or spalls, receives and transfers loads from earth to the rib system, provides a surface against which to place back fill, and provides convenient surface against which to block when it is inconvenient to block against supporting ribs. **Commercial Shearing & Stamping Co., CE-7, Youngstown, Ohio.**

Compaction Chamber Heater

The new Compaction Chamber Heater unit mounts easily on the rear chassis of the MC-500 Curbilder and the element attaches to the Compaction Chamber Housing to permit faster warm-up and more even, smooth flowing compaction in any weather; the element can be moved right or left depending on which side compaction and curb forms are being used. The new Heater is for operation when the Curbilder is only extruding asphalt material.

Another feature of the Propane-fired Heater unit is its easy removal for other jobs such as pre-heating Asphalt Curb Forms for smoother curbing finish, or for heating other asphalt tools, such as Lutes, Hand Smoothers, Scrapers and Finishers. **Miller Spreader Corp., CE-7, 4020 Simon Rd., Youngstown, Ohio.**

Horsepower

Substitution of mechanical horsepower for human muscle-power, is largely responsible for the amazing expansion of the U. S. economy until it leads the world with the highest standard of living. Economists call it the American industrial revolution.

M & H is truly a product of the American industrial revolution. The Company's real growth and development started in 1932, when M & H was reorganized and joined the mechanical horsepower movement. About that time the electric motor was being introduced as a source of industrial power. Realizing this trend, M & H Management redesigned its products and modernized its production equipment.

Slow, tedious, hand-operated manufacturing processes were discarded. Sand equipment, cranes, machine tools, every M & H wheel was soon being turned by electric power.

Rapidly the Company's volume of sales and production began to grow. With the years, it gathered momentum because the M & H plant modernization kept up with new developments and never stopped. The Company's annual sales volume now makes it one of the most successful valve and hydrant producers in the country—thoroughly equipped to provide highest quality products for water works improvements.

(No. 2 of a Series)

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF WALWORTH

Provide Permanent Improvement?

GALVANIZED
OR PAINTED

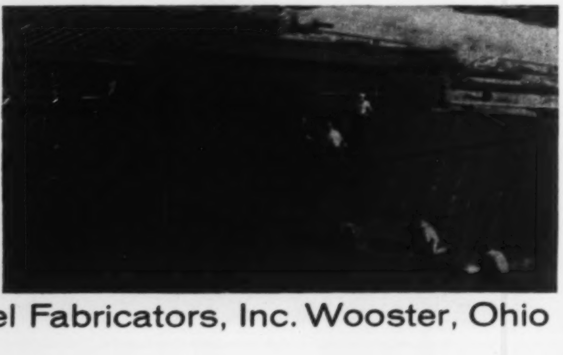
USF

BRIDGE FLOORING
for bridges, overpasses, backing for piling

Economy and maintenance minded budgets suggest consideration of permanent durability, engineered strength and low cost maintenance free service provided by this proven highway material. Send for free design manual.

Highway Guard Rail
Bridge Flooring
Steel Forms for Concrete Bridge Decks
Corrugated Metal Pipe
Window Wells
Metal Doors & Frames
Metal Buildings

USF



United Steel Fabricators, Inc. Wooster, Ohio

EQUIPMENT MATERIALS and METHODS

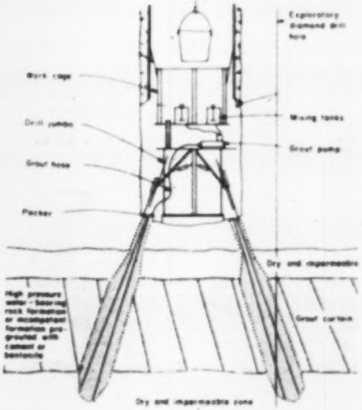
(continued)

New Soil Stabilization & Grouting Concept

An entirely new concept of soil stabilization and grouting is the development of a chemical that turns water into a stiff continuous gel in a controlled period of time.

Known as AM-9 Chemical Grout, it was designed for application by means of a patented process in the mining and construction industries to prevent various types of water seepage. It is available as a dry white powder, and is applied in a non-viscous solution which will penetrate any mass through which water flows.

After the addition of a catalyst, an aqueous solution of AM-9 is injected or percolated through the soil or rock formation. Gelling time is controlled from a few seconds to several hours, depending on the type of catalyst used. The nature of the reaction is such that the viscosity of the solution remains essentially that of water until just before the gel forms.


Exploratory diamond drill hole
Work cage
Drill jumbo
Mixing tanks
Grout pump
Grout hose
Packer
Dry and impermeable
High pressure water-bearing rock formation or incompetent formation pregrouted with cement or bentonite
Grout curtain
Dry and impermeable zone

The gel not only prevents the passage of water through the mass, but also binds together the particles of soil, sand or loose rock and provides a moderate increase in shear strength. Stabilized soils below the water table are believed to retain their properties permanently. **American Cyanamid Co., CE-7, 30 Rockefeller Plaza, New York 20, N. Y.**

Planimeter

A COMPENSATING PLANIMETER with completely built-in recording system for protection against accidental damage and dust is now available.

(Continued on page 129)

EQUIPMENT MATERIALS and METHODS

(continued)

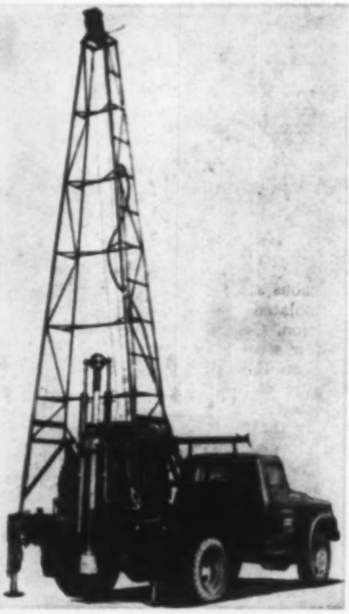
The parallelity of the tracer arm and the wheel axle is adjustable. The vernier reads to 4 digits. The instrument can have either the fixed or adjustable tracer and pole arms. A wide variety of attachments is available, such as: tracing and reading magnifiers, polar disc and pole wagon for conversion to a linear rolling planimeter. **Epic, Inc., CE-7, 150 Nassau St., New York 38, N. Y.**

Truck Mounted Core Drill

Recently the company announced the availability of a new, high capacity core drill known as the Acker Presidenté. Now, this same rig is available for mounting directly on a truck. Power for the unit can be furnished by separate, self-contained gasoline or diesel engines, or direct power-take-off from the truck engine.

The new truck mounted Presidenté can be driven anywhere and is ideal for soil sampling, mineral and petroleum exploration, water well drilling, highway construction, auger drilling, etc. Capacity of this unit is: core drilling to 1000 ft; auger drilling to 300 ft; and holes up to 24 inches in diameter.

Acker Drill Co., Inc., CE-7, P.O. Box 830, Scranton 2, Pa.



Truck Mounted

New! Kinnear POWER OPERATOR

Adds more efficiency than ever to KINNEAR ROLLING DOORS

FINEST ROLLING DOOR OPERATOR EVER DESIGNED

FEATURES:

New "Removable" Design — doesn't disturb auxiliary hand-chain operator.

Any Mounting! Vertical or horizontal — on door or wall bracket, or through-the-wall!

Easy Installation. Simple in-the-field control-wiring to a terminal strip.

Reserve Power for smooth action regardless of wind pressure, drifted snow, collected grime, or extra years of usage.

Thermal Protection Against Overload — motor cuts out before damage can occur.

New Worm Gearing for highest efficiency and longest service.

Centrifugal Clutch transmits motor action to door with no shock. Prevents motor stalls and overload damage.

Seven Sizes! Capacities for doors of any size!

MOUNTS ON DOOR
OR ON WALL....
(OR THROUGH THE WALL)

A new high in door efficiency is reached in Kinnear Rolling Doors equipped with the new Kinnear "Series Three" Power Operator. This is an *all-new* concept in motorization for rolling doors — designed with a single goal in mind — to *reduce to minimum* all chance for troubles from overload, torque shock, constant start-stop action—in a motor that assures easiest installation and maintenance, and permits any type of mounting.

The "Series Three" Kinnear Power Operator, like the Kinnear Rolling Door itself, is the finest achievement today's engineering skills can produce.

Write for new Power Operator Bulletin

The KINNEAR Mfg. Co.
FACTORIES: 1080-90 Fields Avenue, Columbus, Ohio
1742 Yosemite Avenue, San Francisco 24, Calif.
Offices and Agents in All Principal Cities

KINNEAR
ROLLING DOORS
Saving Ways in Doorways

EQUIPMENT, MATERIALS and METHODS

(continued)

New Slide Rule

A NEW SLIDE RULE that mathematically measures truck performance in a few seconds has been developed. The precision instrument eliminates extensive paper work in determining the following information: what horsepower is required to obtain a desired performance including air resistance and road surface, for a specific gross weight; how much gross weight may be carried with a given engine and still attain this desired performance; how steep a grade and at what speed a specific vehicle may climb; what road speed is best for a specific engine and known gross weight; how fast the vehicle may go, based on tire size, engine speed and total gear ratio; what axle ratio is required to attain this maximum speed; and what the engine speed (rpm) is for a known road speed with various tire sizes and total gear ratio.

In that all of this knowledge is relative, certain fact—net engine horsepower, gross weight, per cent grade, speed (mph), gear ratio, engine rpm and tire rpm—must be known to determine an unknown. For instance, if you know engine hp, gross vehicle weight and road grade, one of the dual slides on the White truck performance rule will show the maximum driving speed. **The White Motor Co., CE-7, 842 E. 79th St., Cleveland 1, Ohio.**

Crawler Loader

THE LATEST MODEL SPEEDCAT crawler loader is now offered with all welded main frames for greater strength and longer life. Also electric starting engines have recently been made standard on all models. A three tooth hydraulically operated scarifier is an optional attachment. These new features make this year's Speedcat more rigid, easier to operate, and even more useful than they have been in the past, according to the manufacturer.

These small crawler tractors have proven their ability to reduce hand labor and even replace rubber tired machines twice their size and cost. **Mead Specialties Co., Tractor Div. TR-272, CE-7, 4114 No. Knox Ave., Chicago 41, Ill.**

Hydra-Might

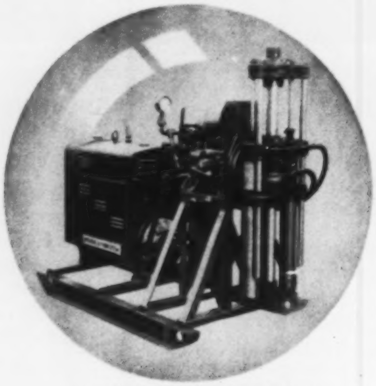
A NEW HYDRAULICALLY ACTUATED percussion type rock drill, the Hydra-Might, is capable of moving a hammer at a rate of 1800 blows per minute using oil. This speed is achieved by the use of a single self-propelled compact unit which operates completely on hydraulic pressure.

The manufacturer states that it is the only drill of its kind, and is fully operational. Its hydraulic action reverses the direction of the oil flow sixty times per second. The Hydra-Might does not require a large, expensive and cumbersome air compressor or air motors for propulsion.

A hydaulic drill, not having to eliminate the oil to atmosphere, but returning it to a sump tank, having no expansion problem, maintains pressure against the hammer until after contact has been made. This produces a heavy, follow up blow that overcomes the inertia of the drill rod, transmits the force to the drill bit points, where the work is done, and makes for faster drilling. As oil pressure is maintained against the top of the hammer until a little after contact is made with the steel, the hammer is not allowed to bounce off the steel. The distributing valve, having micromatic adjustment, permits fine control of the length of the hammer stroke and follow up.

Fully Operational

The Hydra-Might hydraulic drill has definite physical advantages over other percussion drills, including lower cost, the manufacturer states. It is a single self-propelled unit with no cumbersome ground hose lines. The only noise produced by this machine is made by the hammer striking the drill rod. **Florida Builders, Inc., CE-7, 700 43rd St., So., St. Petersburg, Fla.**



S&H MODEL 30

CORE DRILL MACHINE

- LIGHT
- COMPACT
- PORTABLE
- VERSATILE

- The ideal machine for foundation investigation and shallow mineral exploration.
- Available with either screwfeed or hydraulic swivelheads with or without built-in water pump and a wide choice of power units.
- Unit can be skid, truck, or trailer mounted.
- The Model 30 is a quality machine produced by a quality manufacturer.

Look for our emblem... It's your Seal of Quality

SPRAGUE & HENWOOD, Inc.
SCRANTON 2, PA.
MEMBER OF: DIAMOND CORE DRILL MANUFACTURERS ASSOC.

New York • Philadelphia • Atlanta • Pittsburgh • Grand Junction, Colo. • Buchans, Nfld.
Export Division: Sprague & Henwood International Corporation, 11 W. 42nd St., New York, N.Y.

For
CIVIL
ENGINEERS

THE BRUNTON*
POCKET TRANSIT

IT'S HANDY...
weighs only 9 oz.; 2¾" x 3" x 1⅛"; easy to carry in pocket, on belt, in car.

IT'S VERSATILE...
ideal for preliminary and supplementary surveying; used as a compass, transit, level, plumb, alidade, clinometer.
Shows direction to 1°; level, slope or grade within 1°.

IT'S MADE TO LAST A LIFETIME
"Over 60,000 Brunton Transits since 1896"
See your local engineering supply house or WRITE FOR CATALOG
*Brunton is a registered trademark of

WM. AINSWORTH & SONS, INC.
2151 LAWRENCE ST. • DENVER 2, COLORADO

40th YEAR
Spencer
White &
Prentis INC.

FOUNDATIONS
UNDERPINNING
PILING

CATALOGUE
ON REQUEST

10 E. 40th ST., NEW YORK 16
DETROIT: 2033 PARK AVE.
CHICAGO: 221 NORTH LaSALLE ST.
WASHINGTON, D. C.: TOWER BLDG.
PITTSBURGH: EMPIRE BLDG.

Literature Available

CONCRETE CURING COMPOUND—Information is offered on Protex Curing Compounds which are scientifically compounded by new and modern processing equipment, giving positive assurance of adequate curing. Every batch is laboratory controlled during manufacture. Advantages of Protex include: positive curing at low cost; only one inspection required; gives maximum water retention; and it is consistent drum after drum. Literature is also available on Concrete Additives. **Autolene Lubricants Co., CE-7, 1331 W. Evans Ave., Denver 23, Colo.**

ALUMINUM GRATING DESIGN—A brochure is available on a new and improved aluminum grating design in which square cross bars are forced through pierced bearing bars, and then, under tremendous pressure, are squeezed between bearing bars to become permanently locked. This exclusive forming process prevents bars from twisting or turning. Also, there are no bolts, rivets or screws used—nothing to rattle or become loose. **Kerrigan Iron Works Company, CE-7, Eleventh and Herman St., P.O. Box 479, Nashville 2, Tenn.**

STANDARD REINFORCING BAR PRODUCERS—This 12-page pamphlet lists American manufacturers of standard ASTM concrete reinforcing bars with photographic reproductions of bars showing mill marks identifying producer and location of mill. It includes listing of applicable ASTM Specifications and chart showing standard size and weight data. All bars shown meet the requirements of Federal specifications, for use by all Federal agencies and the American Association of State Highway Officials. **Concrete Reinforcing Steel Institute, CE-7, 38 South Dearborn St., Chicago 3, Ill.**

NEW CRANE RATING STANDARDS—In order to reduce confusion and to permit distributors, purchasers and users of power cranes to be able to compare machines on a uniform and equitable basis, the members of the Power Crane and Shovel Association have made available information on a new and uniform method of rating full-revolving power cranes. **Power Crane and Shovel Association, CE-7, 630 Third Ave., New York, N. Y.**

BOLTLESS FLEXIBLE JOINT PIPE—A brochure is offered on the Usiflex Boltless Flexible Joint Pipe. Advantages, assembly installation, development and weights are contained in the booklet. **United States Pipe & Foundry Co., CE-7, 3300 First Ave., North, Birmingham 2, Ala.**

THIS IS THE
CORRECT
EASY WAY

1

PEEL
the STANPAT from its backing.

2

PLACE
the STANPAT into position on the tracing.

3

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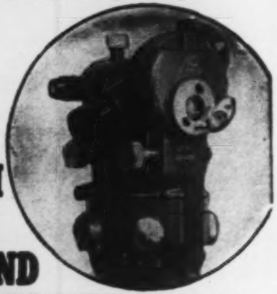

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Literature Available

Permox 1-4-3—An 8-page brochure is available on Permox 1-4-3, the new anti-corrosive pigment, Basic Lead Silico Chromate. Its unique physical properties make it ideally suited for the formulation of primers, intermediate and finish coats, the manufacturer states. This is highly important because it means that this one pigment goes in all three coats and provides maximum rust inhibition in each coat. The booklet is illustrated and specific product data are given. **The Eagle-Picher Co., Chemical Div., CE-7, American Bldg., Cincinnati 1, Ohio.**

Basic Estimating—What machine to use and how much it will do under varying conditions is told in an exceptional booklet. Most of the information needed to determine how to move earth and logs, and handle big pipe and kindred loads by tractors, loaders and haulers is in this publication. The cycle time, effect of altitude on engine power, grades, traction and the like all are fully covered. How to compute the cost to own and operate equipment is detailed for most IH machines, from purchase price through depreciation, insurance, fuel, tires, etc. **International Harvester Co., CE-7, 180 North Michigan Ave., Chicago 1, Ill.**

The Asphalt Handbook—A new and completely revised edition of The Asphalt Handbook, a standard reference work in the field of asphalt technology and construction, has been published. Some of the subjects included in this 398-page book are: uses of asphalt, terms relating to asphalt and its uses, tests, summary of specifications and principal recommendations, thickness design of asphalt pavement structures, and asphalt construction equipment. Additional information about this book may be obtained from the company or its district office. **The Asphalt Institute, CE-7, Campus, University of Maryland, College Park, Md.**

Wrought Aluminum Mill Products Revision—By requesting on their letterhead, readers may receive the third revision of "Standards for Wrought Aluminum Mill Products", a 96-page manual which presents data on mechanical, physical and other properties, standard tolerances and other useful information on standard alloys and mill products normally produced in these alloys. In this revision new data has been added and much of the material has been rearranged by type of product. Included are weight and other data related to specific products, information on thermal treatment, storage precautions and indication limits for ultrasonic inspection. **The Aluminum Association, CE-7, 420 Lexington Ave., New York 17, N. Y.**

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From the MANUFACTURERS

NEW RENTAL HEADQUARTERS: Symons Clamp & Mfg. Co. has started construction of a new office-warehouse in Des Plaines, Ill., which will become a national headquarters for its prefabricated concrete forming equipment rental division . . . **ACQUIRES PLANT PROPERTY:** Ellicott Machine Corp. has acquired the plant of Charles T. Brandt, Inc., located at Bush and Ridgely, Baltimore, Md. It will be operated by Ellicott-Brandt, Inc., a wholly owned Ellicott subsidiary . . . **WOODCREST AWARDED CONTRACT:** Repair work on the deck slabs of the Passaic River Bridge Crossing of the New Jersey Turnpike has been started, the contract being awarded to Woodcrest Construction Co., New York City . . . **EXPANDS FACILITIES:** Hydraulic Unit Specialties Co., Waukesha, Wis., manufacturer of Husco Hydraulic Controls, is moving new equipment into greatly expanded factory space, the third such expansion within a year . . . **MERGERS:** Barber-Greene, Aurora, Ill., and Smith Engineering Works, Milwaukee, Wis., announce the approval of a proposed merger by the Boards of Directors of the two companies. It is based on an exchange of common stock—six shares of Barber-Greene for each share of Smith Engineering Works . . . The officers of The Engineers Collaborative, consulting structural engineers, have announced that the firm of Wiss and Associates has become a part of their organization . . . **NEW PLANTS:** Tennessee Oil Refining Co., a division of Tennessee Gas Transmission Co., has contracted for the construction of a natural gas processing plant near Palacios, Texas. The construction contract has been awarded to the O. L. Olsen Co. . . . Armour Alliance Industries, Alliance, Ohio, announces the opening of a newly-constructed industrial adhesives plant located at Philadelphia, Pa. . . . **RETIREMENT ANNOUNCED:** John D. Biggers has announced his retirement as chairman and chief executive officer of Libbey-Owens-Ford Glass Co. . . . **DISTRIBUTOR APPOINTED:** Pelican Machinery Co., Bossier City, La., has been appointed distributor for northern Louisiana by the Parsons Co., Newton, Iowa, the trencher manufacturing division of Koehring Co. . . . **RESEARCH STUDY LAUNCHED:** The White Motor Co. has launched a comprehensive new research study of all forms of transportation to guide its long-range product development program . . . **PLASTICS COATING DIVISION:** W. S. Rockwell Co., Fairfield, Conn., announces the establishment of a Plastics Coating Division to provide a variety of thermoplastic finishes on surfaces of metal objects for corrosion resistance or decorative purposes . . . **NEW COMPANIES FORMED:** The formation of Ceiling Materials Co., Memphis, Tenn., a new manufacturer and distributor of materials for illuminated ceilings, has been announced. It is an affiliate of Light & Power Utilities Corp., a major manufacturer of commercial and industrial lighting fixtures . . . The formation of Green Bag Cement Co., a wholly-owned subsidiary of Pittsburgh Coke & Chemical Co., has been announced . . . **MOVE ANNOUNCED:** Pacific Mercury's Marketing Division, currently located at 13232 Leadwell, North Hollywood, is moving to the company's home office plant at 8345 Hayvenhurst Ave., Sepulveda, Calif. . . . **APPOINTMENTS:** The appointment of Philip M. (Phil) Dixon as branch manager of the Detroit office of Peerless Pump, Hydrodynamics Div., Food Machinery and Chemical Corp., has been announced . . . As the initial step in an overall program designed to secure a still larger share of export business, the R. H. Sheppard Co., Inc., Hanover, Pa., has announced the appointment of Len Wright to the newly created post of Director of Overseas Operations . . . Bernard G. McNally has been named sales manager of the Equipment Division of the Hauck Manufacturing Co., Brooklyn, N. Y. . . . Copymation, Inc., manufacturers of whiteprinting equipment, announces the appointment of Gordon Estabrook as manager of the company's new Palo Alto, Calif. sales, service and warehouse branch at 715 Loma Verde Ave. . . . Paul J. Jones has been appointed to the position of executive vice president and general sales manager of Moretrench Corp., Rockaway, N. J. Also, Louis B. Jones has been made Eastern District sales manager of the company.

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Journals: Engineering Mechanics, Highway, Hydraulics, Irrigation and Drainage, Power, Soil Mechanics and Foundations, Structural, Waterways and Harbors.

2494. Irrigation and Drainage Problems in Uruguay, by J. E. Christiansen. (IR) Uruguay irrigates about 65,000 acres, mostly rice (74%) and sugar cane (15%). Frequent droughts seriously affect both crops and livestock. Irrigation can be increased by storage in small reservoirs on tributary streams by means of low earth dams.

2495. Heritage of Irrigation in Iraq, by M. R. Lewis. (IR) The history of irrigation in Iraq for 6,000 yr and its influence on the thinking and customs of the people are reviewed. War, floods, excess salts, sedimentation, and changing trade routes are investigated as causes of the decline or abandonment of great irrigation systems.

2496. Review of Research on Composite Steel-Concrete Beams, by I. M. Viest. (ST) Investigations of composite beams carried out in the period 1920-1958 in this country and abroad included both experimental and theoretical studies. Tests of specimens with and without mechanical connectors are summarized, specimens briefly described, and major results discussed.

2497. Analysis of Frames with Nonlinear Behavior, by Alfredo Hua-Sing Ang. (EM) A method for the analysis of frames with nonlinear behavior subjected to lateral deformations is presented. The nonlinear characteristics of both the members and the connections are considered.

2498. Behavior of Viscoelastic Plates in Bending, by George E. Mase. (EM) This investigation deals with the flexural deformation of linear viscoelastic plates. Solutions of the fundamental equation for such plates are obtained by use of the Laplace transformation with respect to time. The quasi-static deflection under various lateral loadings and the dynamic response under no load are presented.

2499. Aircraft Structural Analysis of an Analog Computer, by W. J. Brignac and R. G. Schwendler. (EM) This paper is a brief description of the technique of representing elastic structures by electric analogs with passive elements.

2500. Vibrations and Stability of Plates Under Initial Stress, by George Herrmann and Anthony E. Armenakas. (EM) A linear theory of motion is established which, in addition to initial membrane forces, takes into account initial moments and transverse shear forces.

2501. Computer Analysis of Slope Stability, by John A. Horn. (SM) A computer program has been written which can solve a great variety of slope stability problems. It is possible to analyze a slope with any surface configuration, with one or two soil strata in any pattern, with or without water table, pore pressures, increasing cohesion with depth, tension cracks, rigid base, or loads anywhere on the surface.

2502. Ultimate Strength of Over-Reinforced Beams, by Ladislav B. Kriz and Seng-Lip Lee. (EM) The flexural strength of rectangular, reinforced concrete beams controlled by compression is investigated analytically, using stress distribution derived from experimental stress-strain curves. Empirical expression for the ultimate bending moment is presented and the calculated moments of 59 test beams which failed in compression are compared with the ultimate test moments.

2503. Cooling Water for Steam Electric Stations on Tidewater, by R. W. Spencer and John Bruce. (PO) A review of the circulating water design features and the operating experience of 18 steam electric stations located on the California coast is presented.

2504. Shock Pressures Exerted by Breaking Waves on Breakwaters, by Shoshichiro Nagai. (WW) A study of shock pressures exerted by breaking waves plunging into composite-type breakwaters were studied through the use of a high speed movie camera (3,000 frames per sec), and an electromagnetic ascillograph. Formulas for the prediction of the maximum shock pressure and the maximum resultant pressure per unit of breakwater were derived.

2505. Experimental Study of Beams on Elastic Foundations, by Robert L. Thoms. (EM) The design and use of a structural model for the solution of shear and moment in a beam on an elastic foundation is presented.

2506. Jet Diffusion in Liquid of Greater Density, by G. Abraham. (HY) A study is presented on the influence of the density difference between a jet and the surrounding fluid on the diffusion by a circular, vertical, submerged turbulent jet.

2507. Breakwaters in the Hawaiian Islands, by Robert Q. Palmer. (WW) Breakwaters have been required to create most Hawaiian harbors. Before 1950, the rubble-mound structures were featured by keyed armor stonework. Additional data are needed to develop economical designs.

2508. Containment Studies for an Atomic Power Plant, by William McGuire and Gordon P. Fisher. (PO) A summary of the structural aspects of insuring complete containment for the Enrico Fermi Power Plant in the improbable event of an accident is given. The nature of the critical loading, as well as methods of investigation of structural behavior as a consequence of the loading, is discussed for such emergency conditions.

2509. Structural Engineering Aspects of Nuclear Power Plants, by Lewis L. T. Au and Edward Y. W. Tsui. (ST) A comprehensive description and discussion of structural features in nuclear power plants is presented. Stress analyses in reactor pressure vessels with supports under various loading conditions, and thermal gradients due to convective cooling, are critically reviewed. Effect of dynamic forces and wind on structures is also examined.

2510. Asymmetrical Bending of Conical Shells, by Bayard Wilson. (EM) The equations of Goldenveizer's theory are specialized to the case of conical shells. A method of solution is developed, applicable to truncated cones of finite length, simply supported along two generators, and having any type of support at the ends.

2511. Added Mass of Lenses and Parallel Plates, by Turgut Sarpkaya. (EM) Contained herein is a study of the added mass of lens-shaped bodies, two parallel square plates, and two parallel, infinitely long rectangular plates of various thicknesses. The added masses were determined from a mass-frequency relationship obtained by immersing the objects in water and accelerating them in oscillatory motion. The experimental results are in good agreement with the analytical studies of corresponding potential flows.

2512. Stability Problems of Compressed Steel Members and Arch Bridges, by Georg Wastlund. (ST) The design of compressed steel members (columns) is discussed. Attention is given to the stability of bridge arches in vertical planes, and to the lateral stability of bridge arches braced with transverse struts. Numerical values of parameters are given and applications to practical cases are shown.

2513. Analyzing and Projecting Travel Data, by Wilbur S. Smith. (HW) Projections of travel desires are essential for good transportation planning. This paper describes a comprehensive application of new techniques in a survey of the Washington, D. C., metropolitan area to determine

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the projections needed for planning a transportation system for the area.

2514. Translation of Foreign Literature on Hydraulics, Second Progress Report of the Task Force on List of Translations of the Committee on Hydromechanics of the Hydraulics Division. (HY) In 1958, the Committee on Hydromechanics established a Task Force on List of Translations for the purpose of bringing and keeping the original List of Translations of Foreign Literature on Hydraulics, Manual No. 35, up to date. The second addendum to this manual is presented in this paper.

2515. Design of Self-Supported Steel Transmission Towers, by R. N. Bergstrom, J. R. Arena, and J. M. Kramer. (PO) Present tower design practices are reviewed with discussion of existing codes. The economy of using various materials is discussed and the design of a transmission line is outlined, describing how repetitions of the same tower type offer an opportunity to effect considerable savings.

2516. Stresses due to Thermal Gradients in Reactor Shieldings, by Melvin L. Baron and Mario G. Salvadori. (EM) The stresses due to a sudden rise in surface temperature on one side of a fixed-ended arch with a rectangular cross section are evaluated, and the results are extended to the case of a surface temperature which first increases linearly and then remains constant.

2517. Prediction of Maximum Practical Berth Occupancy, by Thomas J. Fratar, Alvin S. Goodman, and Austin E. Brant, Jr. (WW) Studies of observed berth occupancy patterns at commercial marine terminals have been made. Based on the close agreement between these observed patterns and theoretical frequency distribution functions, a method of predicting maximum berth occupancy has been developed.

2518. Navigation Model Studies of New Ohio River Locks, by Eugene P. Fortson, Jr., and George B. Fenwick. (WW) This paper describes the use of model studies in solving turbulence problems induced by the new high-lift locks of the modernized Ohio River navigation lock and dam system now under construction by the Corps of Engineers. Optimum locations and arrangements of structures are determined for safe passage of large tows.

2519. Stresses Around Rectangular Openings in a Plate, by H. Boyd Phillips and Ira E. Allen. (EM) Curves have been developed for determination of the normal stress around rectangular openings when subjected to uniaxial or biaxial stress fields. Height to width ratios between 0.4 and 2.5 have been studied. The study was made experimentally, utilizing the photoelastic interferometer method of stress analysis.

2520. Regla Steam Electric Station, by George T. Ingalls. (PO) This paper describes the design of a four unit steam electric station. Unusual features include design of foundation to cope with stiff clay and rock strata and slag deposits, outdoor-type construction, strengthening gantry crane, and ventilating louvres for turbo-generator housings.

2521. Flow Losses in the Lower Gila River, by Lawrence F. Pratt. (HY) This paper describes a method for estimating losses from infrequent flows in the lower reaches of the Gila River in Arizona. The same procedure can probably be applied to other intermittent streams if sufficient data are available.

2522. Fundamental Aspects of Thixotropy in Soils, by James K. Mitchell. (SM) Thixotropic phenomena are described, and a hypothesis for thixotropic behavior based on initial nonequilibrium of interparticle forces after remolding or compaction, and subsequent structure changes within the soil, are offered. Experimental results consistent with the hypothesis are presented. Some practical aspects of thixotropy are pointed out.

2523. Static Tension Tests of Compact Bolted Joints, by Robert T. Foreman and John L. Rumpf. (ST) Static tension tests of large butt joints, fabricated from A7 steel, fastened with A325 bolts, and arranged in compact patterns, indicate that present design specifications are unduly conservative with respect to the shear strength of the bolts.

2524. Capacitance Method of Measuring Water Film Thickness, by Robert H. Black. (HY) A water film thickness gauge was developed for making rapid measurements of the depth of a water sheet flowing on a plane surface. The gauge uses the electrical capacitance between a fixed metal plate and the water surface to sense the air gap and, by difference, measure the water depth.

2525. Sedimentation Aspects in Diversion at Old River, by Fred B. Toffaleti. (HY) This paper presents the sedimentation aspects of channel evolution leading to necessity of control. It is shown that the distributary system is in a state of imbalance in sediment transport capacity, the nature of which led to the conclusion that the flow capacity of the Atchafalaya River can be expected to increase annually.

2526. Drag and Lift on Spheres within Cylindrical Tubes, by Donald F. Young. (HY) A method for evaluating the lift and drag forces that are exerted by a moving fluid on a spherical particle resting on the bottom of a cylindrical tube is described.

2527. Drainage and Water Management Research in Western Europe, by William W. Donnan. (IR) An indication is made of the ease with which an American visitor can communicate with the engineers of Western Europe. Brief descriptions of some of the work going on in the countries visited by the author are presented.

2528. Design of Welded Aluminum Structures, by H. N. Hill, J. W. Clark, and R. J. Brungraber. (ST) Design rules are proposed for welded aluminum structures. The proposed design methods are conservative, yet more realistic than previously used design procedures.

2529. Correlation of Vehicle Design and Highway Design, by Richard A. Haber and David K. Witheford. (HW) Past and present developments in the highway field indicate that insufficient coordination of vehicle design and highway design is placing the highway program in a precarious position. The situation calls for a unified research approach supported by industry and all interested groups and agencies.

2530. World Practices in Water Measurement at Turnouts, by Charles W. Thomas. (IR) Measuring devices at farm turnouts on open channel irrigation systems are discussed under six general functional classifications regarding the type of device best suited to meet local requirements are not drawn.

2531. Models Primarily Dependent on the Reynolds Number, by W. P. Simmons, Jr. (HY) The design, construction, and operation of models of closed-conduit fluid systems, and interpretation of test data are discussed. General rules for model size, construction, instrumentation, operating Reynolds number ranges, and data analysis are given.

2532. Discussion of Proceedings Paper 2197, 2199, 2220. (EM) John A. Blume on 2197. K. Yervant Terzian on 2199. John A. Blume, Edward Cohen, and Samuel Weissman on 2220.

2533. Discussion of Proceedings Paper 1800, 2145, 2275, 2277. (HW) L. D. Childs on 1800. George W. Ring on 2145. N. C. Raab, Burton H. Sexton, William R. McConochie, John C. Kohl, Harold M. Lewis, and William H. Claire on 2275. Gerald D. Love on 2277.

2534. Analysis of Load Distribution in the Piles of Piers, by M. A. Gouda. (WW) Simplified assumptions and pile displacements are used to develop the solution. Piers are divided into those having symmetrical and unsymmetrical groups of piles.

2535. Discussion of Proceedings Paper 2022, 2056, 2079, 2224, 2260, 2265, 2310, 2311, 2317, 2335. (HY) J. B. Bryce on 2022. Joseph E. Upson on 2056. Task Group of Hydrologic Data of the Committee on Hydrology on 2079. C. T. Advani on 2224. C. Blanchet, D. R. Dawdy and R. W. Carter, M. Gamal Mostafa, James K. Culbertson and Carl F. Nordin, Jr. on 2260. E. G. Kruse on 2265. John C. Stevens on 2310. Lucien M. Brush, Jr., Hau-Wong Ho, and E. J. Hall on 2311. Remig A. Papp on 2317. William G. Hoyt and E. Shaw Cole on 2335.

2536. Discussion of Proceedings Paper 1963, 1964, 2059, 2153, 2154, 2156, 2160, 2281, 2282, 2283. (IR) Harry F. Blaney on 1963. William W. Donnan on 1964. P. H. McGauhey and Harry Erlich on 2059. N. E. Minshall and D. A. Woolhiser on 2153. William W. Donnan, William F. Long, Herman Bouwer, Jan van Schilfgaarde, R. William Nelson, and John G. Sutton on 2154. W. C. Walton and J. W. Stewart on 2156. William W. Donnan on 2160. Max Suter on 2281. Robert O. Thomas on 2282. Raphael G. Kazmann, Frederick L. Hotes, and Paul Baumann on 2283.

2537. Discussion of Proceedings Paper 1671, 1735, 1739, 1741, 1742, 1743, 1744, 1745, 1746, 1747, 2289, 2291, 2312, 2313. (PO) William G. Huber on 1671. G. F. Sudman on 1735. Addendum to Closure of 1739. Calvin V. Davis on 1741. James J. Growdon on 1742, 1743, 1744. No closure to 1745. J. Barry Cooke on 1746. Luis Henrique Gomes Fernandes, Edgard de Oliveira, and Nuno de Vasconcelos Porto on 1747. F. L. Lawton on 2289. Simon Peters on 2291. F. L. Lawton and William T. Walker on 2312. G. S. Sarkaria on 2313.

2538. Discussion of Proceedings Paper 1864, 2135, 2212, 2214, 2216, 2217, 2292, 2294, 2295, 2320, 2368. (SM) Jose A. Lahoz and Addendum to Closure of 1864. John A. Focht on 2135. G. H. Johnston, G. Robert Lange, Henry W. Stevens and William P. Verville on 2212. Harry R. Cedergren, F. P. Silva, O. H. Gilbert, Jr., and John L. McRae on 2216. Karl H. Evans on 2217. I. da Silveira, O. H. Evans on 2217. S. C. Schiff, Charles Szechy, B. A. Kantey, Yoshichika Nishida, A. A. Eremin, and W. I. Low on 2292. Miles D. Catton, D. J. MacLean and K. E. Clare on 2294. J. K. Sexton, Per Hall and D. F. Murphy on 2295. N. N. Ambraseys on 2320. R. K. Bernhard and D. F. Coates on 2368.

2539. Discussion of Proceedings Paper 2005, 2223, 2256, 2259, 2262, 2305, 2322, 2384. (ST) J. F. Baker on 2005. H. H. Bleich and M. G. Salvadori on 2223. Milik Tichy and Milos Vorlicek on 2256. Elwyn H. King on 2259. Edward Cohen and A. W. Coutris on 2262. Robert Dannemann on 2305. D. M. Brotton and G. D. Galletly on 2322. Ralph L. Barnett on 2384.

2540. Discussion of Proceedings Paper 2168, 2171, 2177, 2301, 2318. (WW) R. G. Dean and P. S. Eagleson on 2168. Omar J. Lillevang on 2171. P. S. Eagleson and R. G. Dean on 2177. J. R. Bowman on 2301. W. C. Q. Joosting on 2318.

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